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Abey, A.E., Apparatus for deformation tests at intermediate strain rates—10^{-2} to 10^{-3} s^{-1}—and at high pressure, 3:1118 (UCRL–79012)
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Volume 3, Number 23, December 15, 1978

ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 55234, 55235

54221 IEA coal research: 1977 report. London; National Coal Board (1978). 16p.

Progress in five projects funded by member nations of the International Energy Agency is reviewed. The projects are the Technical Information Service, the Economic Assessment Service, the World Coal Reserves and Resources Data Bank Service, the Mining Technology Clearing House, and the Fluidized Bed Combustion Project.

54222 Report on Cerchar's activities during the year 1976. Paris; Cerchar (1977). 121p. (In French).

Report presents information concerning organization of Cerchar and gives a detailed description of its services. The greater part of the document is devoted to a description of research made into the following fields: explosives, fire damp and dust explosions, spontaneous combustion, fight against fire-damp and fires, against harmful dusts, pneumoconiosis, rock pressures, timbering, stability of mines and underground quarries, electricity, telecommunications and remote control, machines, various equipment and tests, coking, research into coal and coke constituents, by-products from washing, uses of coal and other by-products, and environmental aspects. (In French)

54223 Coal in the world economy. Panaitescu, A. *Mine, Pet. Gaze;* **27**: No. 7, 293-300(Jul 1976). (In Romanian).

After a discussion of the importance of coal in the world economy, the role of coal in every coal-producing country is shown, and its importance in the Romanian economy is indicated.

PROCESSING

REFER ALSO TO CITATION(S) 54917, 54918

54224 Combustion of coal in fluidized beds. Wright, S.J. *Phys. Technol.;* **8**: No. 6, 244-248(Nov 1977).

The principles and practice of fluiized bed coal combustion are explained.

CARBONIZATION

REFER ALSO TO CITATION(S) 54329, 54344, 54483, 54492

54225 (FE—2782-4) Formcoke Associates proposal review. Phase 1: Pilot plant review. R and D interim report No. 1. O'Hara, J.B.; Howell, R.D.; Attwood, H.S. (Parsons (Ralph M.) Co., Pasadena, CA (USA)). Feb 1978. Contract EF-77-C-01-2782. 41p. Dep. NTIS, PC A03/MF A01.

This interim report reviews the large Experimental Coke Pellet Pilot Plant (ECPPP) located at the Sparrows Point, Maryland plant of Bethlehem Steel Corporation. This plant is designed to produce 500 tons per day of metallurgical grade coke from agglomerating coals through the use of a novel continuous coking process. The design of the facility was based mainly upon earlier work carried out in a nominal 30-ton per day pilot plant at Conoco Coal Development Company's research laboratory at Library, Pennsylvania. This is a proprietary process developed and funded by Formcoke Associates (the Associates), a group composed of Bethlehem Steel Corporation; Republic Steel Corporation; National Steel Corporation; and Conoco Coal Development Company, a wholly-owned subsidiary of Continental Oil Company. Bethlehem Steel is the operator of the ECPPP.

54226 Coal-conversion process. Masciantonio, P.X.; Schowalter, K.A. (to United States Steel Corp.). US Patent 4,094,746. 13 Jun 1978. Filed date 25 Nov 1974. 20p.

This invention is directed to a process for converting coal into useful liquids, solids, and gases by combined processes of coal carbonization and liquefaction in which the carbonization reaction yields hydrogen suitable for the liquefaction. The heavy liquid products from the liquefaction and the carbonization may be combined with the solid char to form a metallurgical coke. Other liquids may be treated and converted into useful industrial hydrocarbon chemicals. The gases from the combined reactions yield a fuel gas as well as a hydrogen stream suitable for use in the overall processing.

54227 Pressurized moving-bed continuous coking. Chamov, A.V. *Koks Khim.;* No. 1, 26-29(Jan 1978). (In Russian).

Horizontal ovens are preferable for this process: they are easier to install and operate, and temperature control is simpler and more effective. However, horizontal ovens are more difficult to charge, especially with moist charges. A mathematical model of the continuous coking process has been constructed and used to design a pilot unit at Avdeev works with a width of 120 mm and caking zone height of 1150 mm. This produced coke of reasonable size consist. The main advantage of the method is its flexibility. (In Russian)

54228 Dry-quenched coke for the foundry. Temkin, N.E. *Koks Khim.;* No. 1, 29-30(Jan 1978). (In Russian).

Dry-quenched coke offers advantages in terms of uniform small size, balanced properties, higher strength and easier handling. Its use in the blast furnace lowers the coke consumption rate. In the foundry there are benefits such as lower sulfur, less degradation and constant size. The dry-quenched coke is less reactive and resistive than conventional coke. Closer study should be given to the use of dry-quenched coke in cupolas, and the results used to re-price this type of coke and to set size limits more appropriate to it. (In Russian)

54229 Physico-mechanical properties of pre-heated charges. Ryabichenko, A.D. *Koks Khim.;* No. 1, 6-8(Jan 1978). (In Russian).

Maximum density of the charge, whether conventionally prepared or stamped, is reached when the charge has been heated to 200C. Any further increase in temperature reduces the bulk density as a result of an increase in the thermal expansion of the individual grains, and internal and external friction. In the cooled charge, however, internal friction is not dependent on the preheat temperature.

54230 Poorly-coking coals from Kuzbassi as formed coke feedstock. Frischberg, V.D.; Nefedov, P.Ya. *Koks Khim.;* No. 1, 4-5(Jan 1978). (In Russian).

A formed-coke plant is under construction at Altai Coke and Chemicals complex. This paper considers coal reserves in the region, notably at Talkinsk where the seams are 67 to 107m thick, and at Kemerovo. Use of these two coal types should yield a formed coke with 10% ash and 0.3% sulphur. The principal reserves in the Kuzbass for formed-coke production are 50 to 60mt of long-flame coals (V.M. 40 to 36%; ash 10 to 24%; sulphur 0.3 to 0.5%).

54231 Coke oven width. Vasilev, Yu.S. *Koks Khim.;* No. 1, 15-20(Jan 1978). (In Russian).

The results of tests on ovens 450 and 410mm wide are reported. No relationship was found between oven width and coke quality, but rather between quality and the coking temperature.

54232 Behavior of coke in large blast furnaces. Nakamura, N. *Ironmaking Steelmaking;* **5**: No. 1, 1-17(1978).

Three blast furnaces were quenched in operation and the contents were examined; the temperature distribution was also measured, using Tempil pellets. The furnaces examined included a low productivity one, which was examined to see what was wrong. Changes in the quality of coke as it descends in the furnace, and coke behavior in the raceway and hearth are reported. The functions required of coke, and the effects of poor coke quality, are explained, together with the coke quality required in large blast furnaces. A theoretical study of the role of coke in large blast furnaces is included.

54233 Coke in the blast furnace. Dartnell, J. *Ironmaking Steelmaking;* **5**: No. 1, 18-24(1978).

Cokes of high mechanical strength can suffer up to 60% reduction in mean size between stockline and tuyeres owing to a combination of mechanical, chemical and thermal effects. Discusses the role of coke as a fuel, as a producer and regenerator of reducing gas, and as a means of providing permeability in the blast furnace charge. High-temperature tests are being developed for determining coke quality.

54234 Application of mathematical models of carbonization in conditions of Czechoslovak coke oven plants. Hercik, M.; Orlik, M. *Hutn. Listy;* **33**: No. 1, 4-7(1978). (In Czech).

Article discusses the use of mathematical models to determine the optimum proportion of gas coals in coking charges.

54235 Effect of preheating on the coking properties of coals. Meyer, C. *Glueckauf-Forschungsh.;* **38**: No. 6, 231-236(Dec 1977). (In German).

Bergbau-Forschung work on the use of charge preheating is described. The results of tests on a number of different blends showed an increase in bulk density, a decrease in coal size, and a small decrease in the volatile matter content. In no case was poorer quality coke produced; for some coals preheating led to an improvement in the M-10 abrasion index.

54236 DKS formed coke process: construction and operating results of DKS-demo plant. Sugasawa, K.; Hirao, E.; Sunami, Y.; Hariki, M. *Sumitomo Search;* No. 18, 1-12(Nov 1977).

Over the last two years, Sumitomo have developed two new coking processes, namely the Sumi-coal system and the DKS-formed coke process. Describes the latter of these claiming that economies can be gained through the use of non-coking coal and by a shorter coking time because of more efficient heat transfer through the briquette than through fine coal. Investment costs for the plant are said to be no higher than for conventional coke oven plant.

54237 Preheating coking coal to produce improved blast furnace coke. Munson, J.G. *Glueckauf;* **113**: No. 20, 987-993(20 Oct 1977). (In German).

Experience with the coke oven and Precarbon charge preheating plant at U.S. Steel's Gary Works is described. When a 12.3 m diameter blast furnace was built, charge preheating was introduced, since a high-strength coke was required. The stronger coke obtained from preheated charges improved furnace burden permeability and increased throughput.

54238 Investigation of the use of pre-heated coking coal. Meyer, C. *Glueckauf-Forschungsh.;* **38**: No. 5, 197-202(Oct 1977). (In German).

Bergbau-Forschung work on the use of preheated coal for coking is reported. The influence of preheating on the coking process, coking time, yield and throughput, and on the strength and size of the coke was investigated. With the same flue temperature, the coking time for a preheated charge can be reduced by a third, compared with the time necessary for a charge containing moisture, and throughput can be increased by up to 65%. Alternatively, using the same coking time, the flue temperature can be reduced by about 200°K to produce better quality coke.

54239 How carbonization and activation process parameters affect the formation of adsorptive and molecular sieve properties in adsorbents based on weakly-caking coals. Saveleva, L.V. *Khim. Tverd. Topl.;* No. 5, 17-22(Sep 1977). (In Russian).

The effect of heating rate, carbonisation temperature and activation temperature on the pore structure and molecular sieve properties of weakly caking coal was investigated. Some measure of control is possible by changing these parameters.

54240 Blending of two Bowen Basin coals for coke making. Johnston, B.K.; Smith, R.J. *Queensl. Gov. Min. J.;* **78**: No. 911, 418-423(Sep 1977).

Coal from the Middlemount seam in the Roper Creek area of Central Queensland was blended for coking tests with coal from the German Creek seam in the adjacent Parrot Creek area. The coal from the Middlemount seam was non-coking, with only 26 percent vitrinite. The coal from the German Creek seam had excellent coking properties and contained 72 percent vitrinite. It had been stored for one year and had undergone some degree of oxidation. Both coals were of similar rank, with vitrinite mean maximum reflectances of 1.28 percent and 1.32 percent respectively. On the basis of petrographic composition, two blends containing 30 percent and 40 percent by weight of coal from the Middlemount seam were carbonized. Coke from the 30 percent blend was acceptable for metallurgical purposes.

54241 Search for supercoke. Bruce, J. *Br. Steel Corp., Open Rep.;* No. 35, 23-27(Sum 1977).

A short review outlining progress in coke production technology by the British Steel Corp. Sets out the problem of diminishing supplies of prime coking coal, especially low volatile strongly caking coal and explains that the provision of good quality coke is being approached along three main lines, namely, blending, preheating and the use of formed coke. These processes are described with reference to BSC experience and the Japanese briquette blending process (the Plum Duff process) is also discussed.

54242 Carbonization theory. Gryaznov, M.S. *Khim. Tverd. Topl.;* No. 3, 104-110(May 1977). (In Russian).

The main reaction in coke formation is thermal radical polycondensation, initiated by thermal destruction of the organic substance of the material being carbonised. During this destruction, the hydrogen is redistributed, giving rise to intermediate meta-stable liquid and gaseous products, all enriched with hydrogen. The theory of the plastic state of coals, and sintering, structuring and solidification of the plastic mass, together with intrusion of stressed semi-coke during the transition to the final coke product is discussed and applied to a series of cases from practice.

54243 Results of research into the production of formed blast furnace fuel in the USSR. Privalov, V.E. *Khim. Tverd. Topl.;* No. 3, 111-114(May 1977). (In Russian).

This survey includes some statistics, and refers in general terms to the Altai coking plant project.

54244 Theory and practice of rational use of coals for production of special types of coke. Makarov, G.N. *Khim. Tverd. Topl.;* No. 3, 115-121(May 1977). (In Russian).

Details are given of the properties required in cokes for various non-furnace applications, and of tests to optimise production of these cokes in ring furnaces.

54245 What part does sorption play in the sintering of carbon materials. Syskov, K.I. *Khim. Tverd. Topl.;* No. 3, 133-136(May 1977). (In Russian).

The physico-chemical processes which occur during sintering or caking are discussed from the point of view of the sorptive reaction of the components of the binder and the filler material. It is proposed that the degree of sintering should be identified by means of a cakeability criterion which is the realtionship between (1) the difference in the coke residue from the binder with and without the filler, and (2) the coke residue from the binder in isolation. A connection has been found between the cakeability criterion and the sorptive capactiy of the filler and compressive strength of the composite as roasted.

54246 Investigation into the behavior of coke oven batteries when working below capacity. Meltzheim, C. *Cent. Doc. Sider. Circ. Inf. Tech.;* No. 10, 2121-2126(1977). (In French).

Paper discusses the meaning of "slowing down a coking plant" and the definition of and search for a minimal working rhythm for a battery of coke ovens. Working parameters to be taken into account when running coke plants under capacity include masonry movement and modification to working pressures for liquids. Practical rules usually adopted in coke plants are discussed.

54247 Perfecting treatment of residual waters from coking process to obtain effluent conforming to a stipulated standard. Daniel, J. *Cent. Doc. Sider. Circ. Inf. Tech.;* No. 9, 1887-1908(1977). (In French).

Report paper describes present state of work by Cerchar (with ECSC's financial help) to establish the elementary treatments necessary, to purify residual coking water, at low cost, to specifications which may be imposed by authorities concerned. Three cleaning stages have been arbitrarily fixed, corresponding to three levels of effluent quality, which take into consideration objectives fixed for the natural surroundings. Presents the results of study of pre-treatments intended to eliminate matter in suspension from coking water, especially flocculated substances. Discusses elimination of ammonia by steaming off; biological purification; and cleansing by using active carbon.

54248 Treatment of coking by-products, especially residual waters. Otto, S.C. *Cent. Doc. Sider. Circ. Inf. Tech.;* No. 7/8, 1621-1649(1977). (In French).

This paper deals only with those processes offering the best hopes of success thanks to the quality of products obtained and the

fact they limit environmental effects. Coking plant gas: elimination of hydrogen sulphide (Otto-Sulfammon, Stretford and Sidman-Otto processes); elimination of ammonia from gas (Retu-Ammon and Phosam processes); and the scope of application and yields are considered. Residual waters: composition, toxicity, biological purification, effect of temperature, oxygen requirements, installations, working principles and results are discussed.

54249 Experience gained during installation and putting into service 7½ metre Solmer coke ovens. Otto, S.C. *Cent. Doc. Sider. Circ. Inf. Tech.;* No. 9, 1873-1886(1977). (In French).

The design of 2 batteries comprising 36 and 72 coke-ovens 7.5 metres high by 0.45 m wide and 16.46 m long, constructed by Societe C. Otto, allows for subsequent construction of a Coaltek preheating system and the addition of a second drum for the oven gas. Installation technical data and conditions during starting up and difficulties encountered are discussed. Describes control methods used to obtain optimum temperature spread. Improvements made to a temperature measuring device giving true temperature over the whole length of the flues, by means of a water cooled sampler, are noted.

54250 Effects of changing entry-pipe configuration on solids carryover when charging preheated coal to the 6.5-m oven. London; British Carbonization Research Association (1977). 22p.

Operation of the standard Coaltek pipeline-charging system normally leads to the entrainment of an unacceptably large amount of solids in the gases emitted during charging. It was believed that the straight, open-ended entry pipe of Coaltek design, inclined at an angle of 18 to 26°, favored the entrainment of coal in the steam, because some of the coal/steam mixture was able to pass through the oven at high velocity; the aim of this study was to determine the effects of changing both the angle of inclination and the configuration of the entry pipe on the solids carryover and the charge profile in the oven.

54251 New aspects of the ICEM process of briquetting coke. Barbu, I. *Metallurgia;* **29**: No. 2, 61-66(1977).

Results of formed coke production tests aimed at producing coke with constant and superior chemical composition, bulk density and strength are reported. (In Romanian)

54252 Results of international cooperation in the use of coal petrography in the coking industry (1970-1975). Kosina, M. *Sb. Pr. UVP;* No. 33, 90-122, 126(1977). (In Czech).

The results of international cooperation, organized by the International Committee for Coal Petrology, as regards micropetrographic methods and their application in the coking industry are evaluated. During the period 1970 to 1975 some 40 laboratories participated in joint exercises dealing with the accuracy of maceral analysis and of vitrinite reflectance, as well as with evaluating the methods used up to now for predicting the properties of coke on the basis of micropetrographical evaluation of the coal charge. The results obtained show that individual macerals are not yet properly classified into individual maceral groups as interpreted by different laboratories. The accuracy of vitrinite reflectance measurements, chiefly dependent on instrumentation, is quite sufficient for technical purposes.

54253 Comparisons of coke produced in different CANMET coke ovens. I. 12- and 18-inch oven coke strengths. Leeder, W.R.; Price, J.T. Ottawa; CANMET (1977). 33p.

This report summarizes a number of tests carried out in more than one oven with the same coking coals or blends to determine how the quality of coke produced from one oven relates to that from the others. Regression analyses indicate that ASTM coke stabilities, ASTM coke hardnesses, and coke tumbler test indices can be related linearly for any pair of ovens.

54254 Development of briquette charge and formed coke technique in Japan (the DKS process). Sugasawa, K. *Technocrat;* **9**: No. 8, 33-38(Aug 1976).

The making and use of the DKS process briquette-formed coke is described. Coal is pulverized to particles under 3mm, mixed in proportions of 70 to 90 percent noncoking coal, 10 to 20 percent coking coal, 10 percent binder, and is fed into a kneader, where the binder is melted by superheated steam and mixed with the coal. The mixture is briquetted into 65 to 125 g pieces and charged into a sloped-bottom coke oven.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 54319

54255 (FE—2349-14) **High temperature gas treating process. Final report, June 1976—July 1977.** Sims, A.V. (Holt (Ben) Co., Pasadena, CA (USA)). 15 Jul 1977. Contract EX-76-C-01-2349. 110p. Dep. NTIS $6.50.

This report presents the results of the Phase I program for the development of a novel process for treating high temperature gas from coal gasification. The process appears to be technically feasible and offers an advantage over existing technology. In comparison with a process employing conventional state-of-the-art methods, the new process gave an increase in net power output of 11.7 percent. Since this improved output is achieved without increasing coal consumption, the effect is to proportionally increase the rated output of the entire power production plant. The increased output is achieved at an estimated cost that is 6 percent higher than for the conventional treating section. This difference is within the normal accuracy for this type of estimate. Furthermore, the cost of the treating section is a relatively small fraction of the cost of the total electric power production plant; thus possible additional cost is not significant. The estimated capital cost for the heat exchange section to serve a 200 MW power plant is $3,239,000. Bench scale testing has tentatively confirmed the suitability of the calculation methods used in the design of the heat exchange tower.

54256 Treatment of solid fuels. Cole, E.L. (to Texaco Inc.). US Patent 4,089,656. 16 May 1978. Filed date 23 Aug 1976. 6p.

Solid fuels which yield low SO_2 emission on combustion are produced by a process which comprises separating the solid fuel into a light portion having a specific gravity of about 1.6 or less and a heavy portion and subjecting the light portion to hydrothermal treatment.

54257 Pyrite removal from coal by bacteria. Golomb, M.; Beier, E. *Bergbau;* **28**: No. 10, 419-422(Oct 1977). (In German).

Paper describes the forms in which sulfur occurs in coal, the effects of the sulfur content, and the microbiology of Thiobacillus ferro-oxidans. Gives the chemical equations which represent the action of bacteria, and curves which represent the growth of microorganisms and their oxidizing action as a function of time for different total sulfur and pyrite sulfur contents, and for various initial pH values. (In German)

54258 Coal desulfurization. Meyers, R.A. New York; Marcel Dekker Inc. (1977). 254p. $29.75.

One of the most important objections to greater use of coal as a source of energy is pollution of the atmosphere, mostly due to the sulfur content. United States coal deposits in the eastern region generally have a high sulfur content, which is largely in the form of pyrite, FeS_2. This book is a survey in depth of actual and potential ways to remove sulfur from coal before use. Although a large amount of the sulfur can be removed as pyrite mineral by physical means, chemical methods are required to complete the process. These methods involve oxidation, reduction, thermolysis, solvent partition, etc. The author of the book devotes much attention to a method that he originated: treatment with ferric sulfate. The great value of this book is that it brings together so much information available only in reports to government agencies, in patents, and in other sources not always easily accessible. The comprehensive scope of the book gives it value as a stimulus for research on methods of potential but undemonstrated value. Its shortcomings are that some parts are much outdated; the chapter on coal structure, for example, gives a model proposed for coal structure published in 1960, and no references more recent than 1968 except one on the Meyers' process for desulfurization.

HYDROGENATION

54259 (BNL—50821) **Flash hydropyrolysis of coal. Quarterly report No. 4, October 1—December 31, 1977.** (Brookhaven National Lab., Upton, NY (USA)). Feb 1978. Contract EY-76-C-02-0016. 64p. Dep. NTIS, PC A04/MF A01.

The principal objective of this program is to experimentally study the process variables and chemistry of the Flash Hydropyrolysis Process, a rapid gas-phase, non-catalytic coal hydrogenation technique developed at BNL for the conversion to gaseous and liquid fuels. The experimental equipment used for this purpose is a highly instrumented 1 inch down-flow tubular reactor originally designed to operate at up to 4000 psi and 800°C, with coal feed up to 1 lb/hr. These conditions are being extended to include temperatures to 900°C at pressures equal to or less than 2500 psi and coal feed to 2 lbs/hr. Coal and char analyses are performed on a routine basis. A second distillation curve was performed on the total organic liquid product, this time extending the distillation temperature range to 350°C. The results were similar to the first curve indicating that the liquid contains approximately 50% BTX (benzene, toluene, xylene) and 50% heavier hydrocarbons. A major portion of the experimental effort was devoted to the study of the effect of coal particle residence time. A number of exploratory runs were also conducted and results are reported here, including the use of a Battelle Treated Coal (BTC-caking coal treated with CaO), a New Mexico subbituminous coal, a mixture of lignite and lignite char and a lignite impregnated with iron.

54260 (FE—2334-9) **Phase and volumetric equilibria in coal hydrogenation systems. Quarterly report, April 1978—June 1978.** Kobayashi, R. (Rice Univ., Houston, TX (USA). Dept. of Chemical Engineering). 1978. Contract EX-76-C-01-2334. 6p. Dep. NTIS, PC A02/MF A01.

Efforts have concentrated on construction of the high temperature bath and partial assembly of the vertical cell/pump. Additional testing of the analysis subsystem has also been conducted. Final system check-out and leak testing for the VLE apparatus was completed. Preliminary temperature stability studies indicate short term fluctuations in temperature on the order of 0.005°C at approximately 85°C and 0.002°C at approximately 30°C. Infinite dilution K-value studies of various alkanes in hydrogen are being conducted at slightly elevated temperatures. Temperature stability studies have been completed on the dew point equipment and measurements of the vapor pressure of tetralin have begun. Unfortunately, small leaks developed in the differential pressure cell, and the system had to be partially disassembled for repair.

54261 (ORNL/MIT—269) **Hydrodynamics of recirculating fluidized beds.** Khan, M.Z.; Berger, S.A.; Gillet d'Auriac, F.S. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). 28 Mar 1978. Contract W-7405-ENG-26. 21p. Dep. NTIS, PC A02/MF A01.

The hydrodynamics of a recirculating fluidized-bed reactor were studied in a 1-atm cold model. The clear plastic model, 4-in.-ID x 110-in.-tall with a 1-in.-OD axially mounted draft tube, was 1:1 scale with the high-pressure system. Correlations for the solids recirculation rates, bottom-zone pressure drops, and stable operating ranges were obtained as functions of the ratio of nozzle-to-plenum gas flow rates. Amount of plenum gas bypassing into the draft tube was determined by tracer experiments. It was concluded that unlike previous studies the draft tube behaved as a fast fluidized bed and not as a pneumatic transport line. Therefore, presently used mathematical models and assumptions must be reexamined.

54262 **Coal hydrogenation catalyst recycle.** Moll, N.G.; Quarderer, G.J. (to The Dow Chemical Co.). US Patent 4,090,943. 23 May 1978. Filed date 28 Feb 1977. 6p.

In the hydrogenation of coal slurried in recycle oil in the presence of a suspended hydrogenation catalyst, a substantial proportion of the catalyst can be recovered for recycle to the process by using a catalyst which is significantly more finely divided than the ash particles from the coal, subjecting the hydrogenated slurry to a gravity concentration process whereby the coarser, ash particles are selectively concentrated in a lower layer and a relatively larger proportion of the finer catalyst particles remain suspended in the supernatant oil, and recycling at least a part of the supernatant oil containing suspended catalyst to the coal hydrogenation process.

54263 **Kinetics and mechanism of hydrogenation of coal.** Gun, S.R. *Indian J. Technol.;* **15**: No. 5, 218-219(May 1977).

Hydrogenation of coal in the presence of a solvent such as tetralin or a catalyst such as ammonium molybdate, or both, takes place in a sequence of four steps, each step having a characteristic activation energy. A rate equation in terms of the concentration of organic benzene-insolubles is proposed.

GASIFICATION

REFER ALSO TO CITATION(S) 54255, 54309, 54320, 54324, 54330, 54496, 54767, 54769, 54772, 54773, 54774, 54775, 54776, 54778, 54780, 54914, 55289, 55384, 55502, 55503

54264 (FE—1207-41) **Gas generator research and development: BI-GAS process. Quarterly report, October—December 1977.** (Bituminous Coal Research, Inc., Monroeville, PA (USA); Phillips Petroleum Co., Homer City, PA (USA)). Feb 1978. Contract EF-76-C-01-1207. 80p. Dep. NTIS, PC A05/MF A01.

The life test of catalysts BCR Lots No. 3896, 3897, 3940, and 3941 was completed. These non-nickel, titania-supported catalysts showed slightly better activity than the alumina-supported catalysts tested previously. However, their activities at normal operating temperatures were not sufficiently high to justify further consideration as PEDU test candidates. The life test of catalysts BCR Lots No. 3948, 3949, 3964, and 3965 was terminated after 530 hours, rather than the usual 800 hours, because of the low activity of all four samples. The deactivation of catalysts No. 3948 and 3949 was unusually abrupt, occurring early in the test following the initial treatment at 800°F and 1100°F. Catalysts 3964 and 3965 had been submitted as improvements over two other catalysts tested a year earlier. Initial conversions were an improvement over the earlier catalysts, but the long-term performance was not significantly better. Evaluation of the data from methanation PEDU Test No. 26 has been completed. Verification was obtained that the catalyst can be activated (reduced) under process conditions expected to exist during startup operations at the BI-GAS pilot plant. Processing of the data from PEDU Test No. 27 has been delayed because of major discrepancies in preliminary mass balance results, and continuing efforts to determine why the activity of the catalyst was so much lower than normal during this test.

54265 (FE—1514-75) **Advanced coal gasification system for electric power generation. Fourth quarterly progress report, July 1—September 30, 1977.** Keairns, D.L.; Salvador, L.A. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Coal Conversion Dept.). 4 Jan 1978. Contract EF-77-C-01-1514. 79p. Dep. NTIS, PC A05/MF A01.

Tests TP-012-3, -4, and -5 were conducted to evaluate geometry changes in the air tube inlet and coaxial fines feed configuration. TP-012-3 and -4 evaluated axial position of the air-fines inlet, and TP-012-5 evaluated a new combustor design which promoted better mixing of the solids and air. This jet mixer was intended to increase the efficiency of fines consumption by combustion and gasification. In addition to the above geometry evaluations, TP-013-1 was run to evaluate reactor performance with various feedstock characteristics. The TP-013 series of tests was planned to evaluate coke breeze, FMC (COED) char, char derived from the Westinghouse PDU devolatilizer and Indiana coal as gasifier feedstocks. Engineering support involved several tasks in support of gasifier testing. These included the design of a new sacrificial elbow configuration for the char feed lines to afford easy replacement of eroded fittings, the jet mixer combustor for TP-012-5 and evaluations of stress corrosion cracking problems on Incoloy 800 pipe. In addition, a computer program was written for online heat and material balance calculations and a program was initiated to study material deposition on refractory walls.

54266 (FE—1545-48) **Evaluation of slag and refractory compatibility for low-Btu gasification of coal for electric power generation.** Snajdr, E.A.; Klaudinyi, B.; Middleton, J.A.; Yang, D.S. (Combustion Engineering, Inc., Valley Forge, PA (USA)). Dec 1977. Contract EX-76-C-01-1545. 210p. Dep. NTIS, PC A10/MF A01.

Bench scale evaluation tests were made on candidate refractory materials considered for use within Combustion Engineering's atmospheric pressure, entrained bed, 5-ton-per-hour coal gasification Process Development Unit (PDU). Bench-scale dynamic slag tests, found to be comparative within a given test, produced relative wastage rates of 1×10^{-3} in.^{3}/in.^{2} hr for the best alumina—chromia refractories to 225 in.^{3}/in.^{2} hr for a 70 percent alumina firebrick. Alumina—chromia refractories with all types of bond schemes did well; fusion cast refractories gave best results. Basic refractories (magnesio—chromite) showed good corrosion resistance, however, uncombined magnesia was dissolved by the coal ash slag. Tests showed that the simulated product gas (without the presence of slag), did not degrade the physical integrity of phosphate-bonded, high-alumina refractories after exposure at 1700 to 2200°F for 100 hr nor at 2600°F for 50 hr despite phosphorus loss. Tests with dry (dew point approximately -60°F) 8 percent hydrogen-92 percent argon showed phosphorus was lost by reduction of P_2O_5 and volatilization of elemental phosphorus at the test temperatures with subsequent deposition of the elemental phosphorus in cool components down stream. Similar tests with wet (dew point approximately +85°F) 8 percent hydrogen-92 percent argon also caused a phosphorus loss with condensation of phosphoric acid upon cooling. Recommendations were made that the findings of this study be correlated with results obtained from a post operative examination of the refractories exposed to the actual environment established in the PDU. This correlation would aid in establishing future laboratory procedures for selecting refractories.

54267 (FE—1794-31) **Coal Feeder Development Program. Quarterly technical progress report, October 1, 1977—December 31, 1977.** Mistry, D.K. (Ingersoll-Rand Research, Inc., Princeton, NJ (USA)). Jan 1978. Contract EX-76-C-01-1794. 101p. Dep. NTIS, PC A06/MF A01.

The following conclusions were drawn. With the screw concept coal can be pumped with the 5.5" diameter screw feeder against gas back pressure up to 300 psig in the extrusion mode with external heat. The coal output is very low (300 lb/hr) due to the limitation imposed by the heat transfer process in this mode of operation. It is essential that the feeder performance be investigated in the extrusion mode without external heat. Screw flight configuration is one of the important parameters affecting overall feeder performance. In order to spray plasticized coal with the NB V-12 machine, injection mode operation is essential. A synthetic fluid (molasses), with viscosity (28 poise) comparable to plasticized Pittsburgh No. 8 coal, has been sprayed. Based on this demonstration, as well as other observations and findings, it appears that it should be possible to spray plasticized coal. The evaluation of piston concepts indicates that further investigation and component feasibility tests must be carried out in selected areas.

54268 (FE—2006-8) **Applied research and evaluation of process concepts for liquefaction and gasification western coals. Quarterly**

progress report, April—June 1977. Wiser, W.H. (Utah Univ., Salt Lake City (USA). Dept. of Mining, Metallurgical and Fuels Engineering). Dec 1977. Contract EX-76-C-01-2006. 122p. Dep. NTIS, PC A06/MF A01.

The projects being investigated apply the expertise developed by the coal research team at the University of Utah to problems in four general areas related to the gasification and liquefaction of coal: Evaluation of process concepts, catalysis studies of fundamental importance, studies of fundamental principles involved, and properties of coal and coal conversion products. The kinetics of the CO/H_2 reaction over $CoCu/Al_2O_3$ catalyst were determined. Catalyst activities and selectivities were correlated with catalyst properties for a number of catalyst compositions. Criteria for optimum selectivity for light hydrocarbon production were developed. The exchange properties of Lewis and Bronsted acids were characterized and used to determine that $ZnCl_2/SiO_2$ behaves as a Bronsted acid. The chemical structure of a coal-hydrogenation liquid was compared with the structures of solvent-refined coals and synthoil samples.

54269 (FE—2012-009) **Pipeline Gas Demonstration Plant, Phase I. Quarterly technical progress report, June—August 1977.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Sep 1977. Contract EF-77-C-01-2012. 89p. Dep. NTIS, PC A05/MF A01.

The ERDA/ICGG Contract, Number EF-77-C-01-2012, for the analysis, design, construction, operation, testing and evaluation of a plant will demonstrate the commercial feasibility of a chemical process for converting coal to a synthetic pipeline gas. Work has been initiated by The Illinois Coal Gasification Group (ICGG) and its major subcontractors, Dravo Corporation, performing the architectural and engineering services, and COGAS Development Company (CDC), the process licensor providing technical support related to the COGAS gasification process. The following tasks have been started: Conceptual Design and Evaluation of Commercial Plant; Site Evaluation and Selection; Demonstration Plant Environmental Analysis; Materials and Licenses; Technical Support; and Project Management. ICGG's first major milestone was achieved with the submission to ERDA of the "60 Day Deliverable" reports including: Management Plan, Conceptual Commercial Plant Baseline, Tabulation of Trade-Off Evaluations, Design Data Tabulation, Drawing/Diagram Documentation Key, Management Plan Annex, Technical Support Plan, and Initial Real Estate Report. Work undertaken in developing the conceptual design for the commercial plant revealed no significant new technical problems. The material and energy balances, the process flow diagrams, and the design data tabulations are sufficiently complete for process evaluation studies to be performed in a timely manner. Technical work in process development is progressing at a satisfactory rate.

54270 (FE—2036-23) **Liquid Phase Methanation, Pilot Plant operation and laboratory support work. Quarterly report, July 1—September 30, 1977.** (Chem Systems, Inc., New York (USA)). Dec 1977. Contract EX-76-C-01-2036. 62p. Dep. NTIS, PC A04/MF A01.

In Run 3, synthesis gas from IGT's HYGAS reactor was fed to the LPM unit for a total time of 70 hours. A considerable amount of catalyst was entrained out of the reactor when difficulties were encountered during the start-up. CO conversions ranged from 46 to 96 percent depending upon gas feed rate, reaction temperature and pressure. Between Runs Nos. 3 and 4, fluidization tests on the catalyst used in Run No. 3 were performed in Chem Systems Process Development Unit, also located at the research facilities. Results from these tests showed that until the process liquid temperature is above 350°F, reducing its viscosity to a low value, only small oil flows can be used in the reactor. A revised start-up procedure was incorporated for Run No. 4. Additional catalyst was added to make up for that lost during the previous run. Start-up went smoothly and the run lasted 44 hours. The feed gas for this run was synthesis gas from IGT's steam-methane reformer containing 10 to 13 percent CO. Poor gas distribution within the reactor led to high localized gas velocities and caused a considerable amount of catalyst to be entrained out of the reactor. This catalyst was collected downstream on the process oil filters. The run was terminated due to a small fire which developed at a leaking flange. The fire was quickly extinguished with no damage done. Before starting another run, it was decided to make modifications on the gas feed system in order to improve gas distribution within the reactor. Bench Scale Unit tests were made on other formulations of the INCO catalyst. In addition, a batch of the Calsicat catalyst used in pilot plant Runs Nos. 1 and 2 was tested in the bench scale unit. These results showed that reduction procedures used during those earlier runs should have been adequate for normal catalyst activity. The reason for its lower than expected activity could also be attributed to poor gas distribution within the pilot plant reactor.

54271 (FE—2036-27) **Liquid phase methanation, pilot plant operation and laboratory support work. Monthly report for April 1978.** (Chem Systems, Inc., New York (USA)). Jun 1978. Contract EX-76-C-01-2036. 42p. Dep. NTIS, PC A03/MF A01.

Run 6 with catalyst No. 038-A $^1/_8$ in. tablets began with catalyst reduction. Oil was introduced into the reactor and the reactor was maintained at 550°F and 80 psig for two days with no gas flow and only a low oil flow. On April 3, the settled bed height was measured (4.6 ft) and a liquid-only fluidization study was begun. This work was completed two days later, and a fluidization test with nitrogen and oil simulating standard reactor conditions was then run. Results of the liquid-only fluidization study are given. Initially, the bed expanded up to 10 percent with increasing liquid velocity. When attempts were made to repeat these data points a few days later, the bed expansion was virtually nil. Evidently, catalyst bridging had occurred and the bed remained in a packed configuration, even at maximum available oil velocities. The addition of gas flow also did not affect the bed height. Four filters plugged during the first week of oil-only circulation. This was substantially less plugging than had been experienced during the previous run with Calsicat catalyst. With fluidization tests completed, the pilot plant was placed in a standby mode since no gas was available for methanation.

54272 (FE—2286-24) **Preparation of a coal conversion systems technical data book. Project 8979 quarterly report, August 1—October 31, 1977.** (Institute of Gas Technology, Chicago, IL (USA)). Feb 1978. Contract EX-76-C-01-2286. 147p. Dep. NTIS, PC A07/MF A01.

Correlation equations used in the preparation of charts showing partial pressures of NH_3 and H_2S in the NH_3-H_2S-H_2O subsystem are summarized and the calculation procedure is described. A new formula for calculation of calorific value of coal from its ultimate analysis is developed and compared with four other published correlations using a large data base of American coals. An attempt is made to estimate that part of the standard deviation of the new formula that can be attributed to the deviations from unknown sources. Equilibrium constants are presented for a number of reactions encountered in coal conversion processes. Problems of predicting acceptor (limestone and dolomites) performance in fluidized-bed combustion are reviewed and discussed. Tar and light oil yield in pyrolysis is characterized, and a summary of Fischer Assay data for various coal types is given. Saltation velocity correlations for horizontal gas-solid transport are compared with the available data on saltation velocities. Pressure-drop correlations for horizontal dilute-phase conveying lines were compiled along with relevant pressure-drop data. A preliminary report on bed-tube phenomenon in fluidized-bed combustion systems is prepared. Effect of solvent/coal ratio and slurry velocity on heat transfer coefficient for slurry preheaters is described. A comparison of calculated fluid-temperature profile and heat transfer coefficient with their experimental values in SRC slurry preheaters is presented. An analysis of the differences between the two values is also described. A write-up on Elemental Composition and Fusibility of Ash prepared for the Data Book is included for review and comments.

54273 (LA—7336-PR) **Combined CO_2—O_2 underground pyrolysis-gasification of southwestern coals. Progress report, July—September 1977.** Vanderborgh, N.E. (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 34p. Dep. NTIS, PC A03/MF A01.

The Los Alamos Scientific Laboratory (LASL) is studying an advanced concept for underground coal gasification that has been designed to address the deeply lying subbituminous seams in the Southwestern United States. The intent of these studies is to evaluate, both with laboratory experiments and computer simulations, the processing options available when dealing with low moisture content coals, as are found in the southwestern region. This report presents an overview of the LASL program and describes theoretical and experimental work in progress. It also includes preliminary engineering assessments and concludes with a description of proposed field experiments. The combined pyrolysis-gasification process requires that the heat output and mass output of two separate underground processing zones be efficiently coupled together. The engineering feasibility of this approach is explored. Specific engineering calculations were performed to address unresolved questions.

54274 (MIT—2295T9-6) **Computer-aided industrial process design: the ASPEN project. Sixth quarterly progress report, September 1—November 30, 1977.** (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Dec 1977. Contract EX-76-C-01-2295-009. 90p. Dep. NTIS, PC A05/MF A01.

The preliminary functional specifications for the ASPEN computer-aided process design system were prepared to describe the requirements of the ASPEN Executive, the Computational Architecture, the Unit Operations Subsystem, the Physical Property Subsystem, and the Cost Estimation and Economic Evaluation Subsystem. A sequential modular approach has been selected as the basic architecture for ASPEN. However, the design of the system will be carried out in such a way as to permit the system to be extended to include simultaneous modular approach as an option. Simulation of the Conoco CO_2 Acceptor process using the prototype simulator, PLEXSYS II, is being carried out. The best estimation techniques

for the physical properties of coal liquids are being sought. Also the development of methods and programs for calculating phase and chemical equilibrium was continued. Considerable time was spent in studying the calculation methods for solids handling operations, conventional reactor models, coal gasifiers, sizing and costing of equipment and data regression. Various existing programs in these areas were acquired and evaluated for the requirements of ASPEN. "A Comparison of Languages for the ASPEN Execution" is included as Appendix II.

54275 (MIT—2295T9-7) **Computer-aided industrial process design, the ASPEN Project. Functional specifications for ASPEN. Appendix I to sixth quarterly progress report.** (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Dec 1977. Contract EX-76-C-01-2295-009. 231p. Dep. NTIS, PC A11/MF A01.

The formal statement of the functional requirements of the ASPEN system is contained in the statement of work for the contract between M.I.T. and the Department of Energy (Contract No. E(49-18)-2295 Task No. 9). A summary of these requirements is presented here. The purpose of this document is: (1) to expand on the work statement and resolve ambiguities, (2) to describe what functions the system will perform in sufficient detail to permit system design, and (3) to serve as a communication vehicle with the Advisory Committee and the Department of Energy. It is important to note that these functional specifications are intended to define what the system will do, but not necessarily how it will be accomplished. In practice, some idea of how the functions might be accomplished is necessary to understand the functions. Therefore, where we know of ways in which functions might be implemented, we have stated them to improve understanding of the functional specifications. Separate sections discuss the ASPEN executive functions, the computational architecture, the physical property and data regression subsystems, the unit operations subsystem and the cost estimation and economic evaluation subsystem. This document will serve as the basis for ASPEN system design specifications.

54276 (NP—23271) **Gasification of peat: a literature review.** Leppaemaeki, E.; Asplund, D.; Ekman, E. (Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland)). Dec 1976. 56p. Dep. NTIS (US Sales Only), PC A04/MF A01.

Gasification of solid fuels has become practical during the last few years as a consequence of the changed price development of fuels. This literature review contains information about the processes, in which peat has been gasified. These processes are divided into two groups, i.e., into commercial and non-commercial ones. The former group includes Lurgi, Koppers-Totzek, Winkler and the usual generator gasifying (e.g., a Soviet sod peat gasifier) processes. The latter group includes processes designed for peat gasification or research results obtained from experiments with peat in the laboratory or on a pilot plant scale. Different peat sorts, such as sod and milled peat and peat briquettes, have been objects of research. All the experiments reviewed were completed before the 1960's, and the aim was to collect information about these experiments for planning peat gasifying tests to be performed in the near future.

54277 (ORNL/TM—6263) **Assessment of environmental control technology for coal conversion aqueous wastes.** Klein, J.A.; Barker, R.E. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 112p. Dep. NTIS, PC A06/MF A01.

A hydrocarbonization process has been studied to assess environmental control technology for coal conversion wastewaters. Fifteen major wastewater streams were identified; 2 present serious environmental problems not routinely encountered in industry. These are the hydrocarbonization condensate and the ash sluicing waste from the gasifier. The hydrocarbonization product water is high in phenolics, ammonia, cyanide, thiocyanate, and other sulfur compounds. This stream will present a significant wastewater treatment problem unless the stream can be recycled internally. The gasifier-ash sluicing water will probably be similar to ash sluicing water from coal-fired power generating plants. However, the large quantity of toxic trace elements may be more easily dissolved from ash produced at the lower-temperature and reducing conditions encountered in gasification. A number of cleanup technologies relevant to the cleanup of coal conversion aqueous effluents have ben assessed for their adaptability to the specific pollutants found in coal hydrocarbonization wastewater. A summary of these processes lists the potential applicability, economics, raw material requirements, process compatibility, operating conditions, state of development, environmental problems, energy requirements, and availability of each. Indications are that almost any level of removal can be achieved if one is willing to pay the cost. The optimum amount of cleanup will require much future interaction between industry, environmental control technology developers, human and environmental effects assessors, and federal effluent regulations administrators.

54278 (ORNL/TM—6265) **Scoping study on two flash hydropyrolysis processes.** Singh, S.P.N. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 76p. Dep. NTIS, PC A05/MF A01.

A scoping study was performed on two conceptual flash hydropyrolysis processes. The two processes selected were the Cities Service and the Schroeder-Spencer Chemical Company (SCC) processes because they represent two aspects of the flash hydropyrolysis technology. The Cities Service process was designed primarily to produce substitute natural gas from North Dakota lignite, while the Schroeder-SCC process was designed primarily to produce a crude aromatic distillate-type oil from Pittsburgh No. 8 bituminous coal. Preliminary mass and energy balances were developed for conceptual plants designed to produce 250 MMscfd of substitute natural gas by the Cities Service process and 50,000 bbl/day of distillate oil by the Schroeder-SCC process. Preliminary economic evaluations were also made on the two processes based on cost data reported by the two process developers. The usable fuel energy efficiency of the Cities Service process was calculated to be 62 percent, while that for the Schroeder-SCC process was calculated to be 76 percent. The preliminary evaluations indicate that a more detailed engineering evaluation of the flash hydropyolysis process is justified after a firm data base for the process is established.

54279 (SAN—1429-28) **Molten Salt Coal Gasification Process Development Unit. Quarterly technical progress report No. 7, October—December 1977.** (Atomics International Div., Canoga Park, CA (USA)). 16 Jan 1978. Contract EF-77-C-03-1429. 23p. Dep. NTIS, PC A02/MF A01.

Construction work at the site of the Molten Salt Coal Gasification Process Development Unit (PDU) continued, reaching approximately 40 percent completion. All process equipment items have been ordered, and 75 percent have been delivered to the site. Delivery schedule problems have been encountered with several of the remaining 25 percent of the equipment items, and a major expediting effort was initiated in an attempt to secure prompt delivery. Engineering work was performed to prepare a design package covering installation of the solids handling system, and bids were solicited on the construction activity. Work continued on the materials surveillance task with the procurement, marking, and storing of archive samples representing materials used in construction of the PDU. Preparations for startup were initiated.

54280 (SVF—46) **Study of flow behaviour in a fast fluidised bed.** Berge, N. (Stiftelsen foer Vaermeteknisk Forskning, Studsvik (Sweden)). Sep 1977. 29p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

As part of a coal gasification project a flow study on fast fluidization has been made. The study was performed in a plexiglass-model of the gasification reactor with a plastic powder fluidized by air. It has been shown that fast fluidization is possible even with relatively coarse particles and that the residence time for the particles in the reactor is five times greater than with pneumatic transport. The difference between a fast fluidized bed working with coarse and one with fine particles seems to be that the turbulence scale is larger and that there is no smooth transition from the fluidized to the fast fluidized state when using coarse particles.

54281 (UCID—17859) **Analysis of Hanna II in-situ coal gasification experiments.** Cena, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jul 1978. Contract W-7405-ENG-48. 19p. Dep. NTIS, PC A02/MF A01.

Two interesting results are evident from the material balances presented: (1) A large, unreacted CHAR zone is calculated to remain following gasification, in both cases, and, (2) very little water is calculated to enter into the overall reaction. For Phase I a total of 1143 tons of coal were affected with 493 tons gasified and 649 tons carbonized only. For Phase II, a total of 2124 tons of coal were affected with 830 tons gasified and 1293 tons carbonized. In view of the heterogeneous nature of Hanna coal, the apparent conclusion of a large char zone may be partially offset by differences in the composition of coal actually entering into gasification. However, since coal composition is one of the few parameters which can be measured in a field experiment, uncertainties in this area should be eliminated, so that more abstract parameters such as unreacted char formed may be addressed.

54282 (UCRL—81252) **Use of tracers in laboratory and field tests of underground coal gasification and oil shale retorting.** Lyczkowski, R.W.; Thorsness, C.B.; Cena, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jun 1978. Contract W-7405-ENG-48. 18p. (CONF-780723—2). Dep. NTIS, PC A02/MF A01.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

Tracers have recently been suggested for laboratory and field experiments of simulated and actual underground retorting of coal and oil shale. The intended use of laboratory and field retort testing is examined and found to be mainly for estimation of properties of the flow field. The field implementation, data reduction procedure

and preliminary results of helium tracer work at Hoe Creek II coal gasification experiment are presented. It was found that the active void volume calculated from the tracer data generally agrees with the consumed coal volume determined from material balances. One and two-dimensional dispersion models predict a highly dispersive system. This review of tracer theory and its usual laboratory application has served to point out its limitations and proper usage. The usage of tracer theory in laboratory and field tests of UCG and oil shale retorting was found to include: generation of information on the flow properties; determination of the total amount of active void volume; determination of the dispersiveness of the injected gas; and analysis of flow channeling and fissuring. At this time lack of knowledge of the flow field needed for interpreting the tracer experiments makes the analysis difficult. In order to understand the tracer data, a theory involving the solution of an inverse problem needs to be developed.

54283 (UCRL—81302) **LLL underground coal gasification project: 1978 status.** Hill, R.W.; Thorsness, C.B.; Stephens, D.R.; Thompson, D.S.; Aiman, W.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1978. Contract W-7405-ENG-48. vp. (CONF-780723—5). Dep. NTIS, PC A02/MF A01.

From 4. underground coal conversion symposium; Steamboat Springs, CO, USA (17 Jul 1978).

Results from the recent LLL underground coal gasification experiment, Hoe Creek No. 2 are presented. It was a two process-well experiment, using both air and oxygen/steam injection: both low and medium-Btu gas were produced. The process wells were spaced 18 m (60 ft) apart and completed within 1.5 m (5 ft) of the bottom of the 7.6 m (25 ft) thick subbituminous coal seam (Felix No. 2), located 38 m (125 ft) below the ground surface. Reverse combustion was used to enhance permeability for Hoe Creek No. 2. The reverse combustion link was completed in 14 days using air injected under high pressure. Following this, gasification was carried out in forward combustion for a period of 58 days. During forward gasification 1635 m^3 (2436 tons) of coal were consumed producing gas which averaged above 96 kJ/gmol (108 Btu/scf), during air injection. A two-day steam/oxygen burn produced medium Btu gas between 220 to 265 kJ/gmol (250 to 300 Btu/scf) with no operational or safety problems. Good quality gas was produced using oxygen in the same geometry that, with air, produced poor quality gas. This suggests that oxygen injection produced a much hotter burn, consuming the oxygen close to the injection well. It may therefore be possible to obtain better control over product gas quality when using oxygen than when using air. These results are quite encouraging for the commercial prospects of steam/oxygen underground coal gasification. The potential of explosively drilled linkages for underground coal gasification using shaped charges was investigated in a two-part study. The first involves testing of a series of conventional shaped charge designs. The second involves design of a tandem shaped-charge, which incorporates two explosive devices into a single assembly. Calculations indicate that a tandem unit could produce approximately 50% greater penetration than could a single stage device.

54284 **Methods of fluidized production of coal in situ.** Terry, R.C. (to In Situ Technology, Inc.). US Patent 4,093,025. 6 Jun 1978. Filed date 23 Nov 1976. 12p.

A method of producing combustible gases, synthetic crude oils, coal chemicals and heat from coal in situ utilizes the combined teachings of in situ gasification, liquefaction and pyrolysis.

54285 **Sealing an underground coal deposit for in situ production.** Terry, R.C. (to In Situ Technology, Inc.). US Patent 4,093,310. 6 Jun 1978. Filed date 19 Sep 1977. 8p.

A previously mined underground coal deposit is sealed so that the underground void space can be pressurized for production by in situ techniques. Excavated communication passages are sealed by barricades which are further sealed by applying hydrostatic head pressure. Subsidence cracks are sealed by injection of mud slurry with additional sealing effected by maintaining hydrostatic head pressure with a column of the slurry. In situ production wells are drilled into the coal with hermetic seal accomplished in part by cementing a portion of the liner to the well bore and in part by the hydrostatic head pressure of a mud slurry positioned above the cement seal. Coal is ignited and burn patterns are established to cause reasonably uniform subsidence.

54286 **Producing methane from coal in situ.** Terry, R.C. (to In Situ Technology, Inc.). US Patent 4,089,374. 16 May 1978. Filed date 16 Dec 1976. 10p.

A well is drilled from the surface of the earth into an underground coal formation. The coal seam is fractured by fluids injected under pressure. Methane entrained in the cracks and fissures is removed to surface facilities. Coal seam in the vicinity of well bore is partially dewatered. Diameter of well bore in the coal section is enlarged first by underreaming the hole, then by a vertical in situ burn to form a collection chimney. Methane desorbed from the coal is withdrawn to surface facilities.

54287 **Process for purifying gases from the gasification of fossil fuels.** Bratzler, K.; Doerges, A.; Hochgesand, G.; Kriebel, M. (to Metallgesellschaft AG). US Patent 4,088,735. 9 May 1978. Priority date 10 Jul 1974, German, Federal Republic of (F.R. Germany). 8p.

A process is disclosed for purifying gases produced by the gasification of fossil fuels by a treatment with water vapor and oxygen under superatmospheric pressure. The raw gas produced is treated to remove catalyst-deteriorating impurities such as mono- and polyunsaturated hydrocarbons, mercaptans, HCN, HCl, H_2S, CS_2, COS, and NH_3, and to desulfurize the gas to produce an exhaust gas which is rich in H_2S. The gas is cooled and scrubbed under superatmospheric pressures and at normal temperatures. The raw gas, at a temperature of 150°—170°C, is indirectly cooled to ambient temperature. The condensible hydrocarbons are then separated and removed, and the gas is then scrubbed with water to remove ammonia in a first scrubbing stage wherein the rate of water addition is controlled to be just sufficient to remove the ammonia. The gas is then scrubbed with a high-boiling organic solvent which is miscible with water and to which sulfur has been added in a second scrubbing stage in which the rate of solvent addition is controlled in dependence on the solubility of the methyl mercaptan, which is to be removed, in the solvent. The gas is scrubbed with the same solvent in a third scrubbing stage in which the water content of the solvent is kept at 5—30 mol percent H_2O in which H_2S and COS are entirely and selectively removed from the gas. Lastly, the scrubbing agents from the second and third scrubbing stages are separately regenerated and recycled to the second and the third scrubbing stages for re-use.

54288 **Process and apparatus for a pressure gasification of fuels mainly in lump form.** Kohlen, R.; Baron, G.; Bierbach, H.; Hafke, C. (to Metallgesellschaft AG). US Patent 4,088,455. 9 May 1978. Priority date 27 Feb 1976, German, Federal Republic of (F.R. Germany). 4p.

A process and apparatus are described for the continuous gasification of fuels, which are mainly in lump form. The fuels are subjected to a superatmospheric pressure in a fixed bed treatment with a gasifying agent consisting of gases which contain free oxygen and water vapor and/or carbon dioxide in a water-cooled reactor housing. The housing contains a substantially conical rotary grate, which is rotatably mounted in the lower portion of the reactor housing and serves to discharge the gasifying agent into the reactor shaft and permits the removal of gasification residue from the shaft. The gasifying agent is positively distributed in correspondence with the quantity of fuel, which increases in the radial direction of the shaft resulting in an approximately uniform time of contact between the gas and fuel across the entire shaft area.

54289 **Medium Btu gas from coal: a possible solution to the U.S. energy crisis.** Taffe, P. *Chem. Age (London);* **116**: No. 3055, 8-10(3 Mar 1978).

The future of coal gasification in the US, and in particular the potential of the Winkler process, are discussed. The economics and the efficiency of the Winkler process are considered. It is believed that medium Btu gas from coal is a better solution to the US energy crisis than is SNG made from coal.

54290 **Westinghouse gets the cake and gasifies it.** Salvador, L.A. *Electr. Rev. (London);* **202**: No. 9, 27-29(3 Mar 1978).

The Westinghouse fluidized bed gasification process can be used to convert caking and non-caking coals without pretreatment into a clean gas which could be used for combined cycle electricity generation. The present stage of development of the process is described.

54291 **Coal: burn it or convert it.** Grainger, L.; Paul, P. *Energy Dig. (London)*; **6**: No. 4, 4-7(Oct 1977).

A shortened version of a paper presented at the Eurochem conference. Brief details are given of Plan 2000 and developments in coal gasification and liquefaction.

54292 **Mathematical model: fixed-bed pressure gasification of coal.** Biba, V. *Khim. Tverd. Topl.;* No. 5, 75-84(Sep 1977). (In Russian).

The model presented is based on the conservation of energy and mass. A computer is used to find the concentration and temperature profile for solid and gas phases over the producer.

54293 **Cold model concept.** Eddinger, R.T. *CHEMTECH;* **7**: No. 9, 556-558(Sep 1977).

The cost and time of development of a coal conversion process can be reduced by studying the flow problems in a scale model which operates at room temperature. The use of such models, particularly during the development of the char gasification step of the COGAS process, is described.

54294 Corrosion design problems in coal conversion plants. Lockman, W.J.; Howell, R.D. *Mater. Performance;* **116**: No. 7, 43-47(Jul 1977).

Problems associated with conversion of coal to liquid and gaseous fuels are reviewed. Attention is given to materials selection and to design problems created by operation at up to 1650°C, pressures of 7 to 35 MPa, the addition of hydrogen, abrasion, and to attachment problems with refractory linings, condensation in cold shells, welding of vessels and the inspection of thick, large vessels. Piping, valves, pumps, turbines, high temperature particulate filters, heat exchanngers, heaters, instruments, and hydro and cyclone separators are discussed.

54295 (DOE-tr—88(Vol.4)) **Research and development on steam gasification of coal. Status report at end of concept phase, August 1, 1975—November 30, 1976.** (Bergbau-Forschung G.m.b.H., Essen (Germany, F.R.)). Dec 1976. Translation of German report. 81p. Dep. NTIS, PC A05/MF A01.

The plant designed for coal gasification with steam is connected to a high-temperature reactor (HTR) and operates at 40 bar pressure. Various processes known from conventional gasification technology were adapted on a case by case basis to the requirements of a combined nuclear plant and gasification installation and optimized. The resulting gas generator is an entirely new development in which the nuclear reactor-heat is transferred via a pipe heat exchanger with circulating helium to a fluidized bed of coal and steam. Its key problems are the development of a suitable material for the heat exchanger and the determination of reliable data for the sequence of and products of gasification with regard to the total planning concept. According to the material study, there are already materials which can be used for a sufficiently long period in the gas generator. The data about the reaction rate, heat requirement, fluidized bed density and heat transfer from the heat exchanger to the fluidized bed needed to determine the gasification data were measured in the laboratory and in a small-scale, kg-sized plant. Besides the use of steam as gasifier, studies were performed using mixtures of steam and hydrogen. The latter are of particular importance to hydrogenation in combination with the steam gasification of coal. It is of great importance to the transferability of the results to large-scale plants that the tests were performed with semicommercial equipment in which the gasification was performed in a section of the large-scale gas generator with heat introduction from the helium circuit.

54296 Coal gasifier having an elutriated feed stream. Matthews, C.W. (to Gulf Oil Corp.). US Patent 3,971,635. 27 Jul 1976. vp.

Gulf Oil Corp.'s newly developed nonpolluting coal gasification process incorporates improved process economy (especially in water usage) and reliability. Water makeup for use as steam or as wash water may include polluted, solids-containing water from other processes. In the process, a first stream of coal is burned without bed formation in a combustion zone in the presence of water under oxidation conditions (2200 to 3300°F; residence time of up to 30 sec) to produce gases containing carbon dioxide and steam. A second stream of coal is maintained as a fluidized bed in a separate gasifier zone by upflowing carbon dioxide and steam from the combustion zone, while being gasified under reducing conditions (1400 to 2000°F; 10 psi) to produce carbon monoxide and hydrogen. Feed coal for both streams is crushed and then elutriated to remove coal fines (which are too small to be retained in the gasifier fluidized bed) from coarse particulates. The elutriated fines are water-scrubbed to form a slurry which comprises all or part of the first stream of coal entering the combustion zone, while the coarse particulates comprise the second stream.

54297 Coal gasification process utilizing high sulfur carbonaceous material. Matthews, C.W. (to Gulf Oil Corp.). US Patent 3,971,638. 27 Jul 1976. vp.

In Gulf Oil Corp.'s coal gasification process, a high-sulfur carbonaceous material from an external process can be used in part as the first stream of coal entering the combustion zone. The sulfur dioxide produced is reduced entirely to hydrogen sulfide by passage through the fluidized-bed gasifier.

54298 Fluid bed coal gasification. Matthews, C.W. (to Gulf Oil Corp.). US Patent 3,971,639. 27 Jul 1976. vp.

Gulf Oil Corp.'s fluidized-bed coal gasification process offers increased process efficiency by avoiding solids flow downward from the gasifier zone directly to the combustion zone. In this approach, char produced in the fluidized bed is elutriated overhead and material in the fluidized bed is prevented from direct entry into the combustion zone. The ratio of carbonaceous material to ash in the char removed overhead is thus lower than the average ratio of carbonaceous material to ash in the solids in the fluidized bed.

54299 Condensate scrubbing of coal gasifier product. Matthews, C.W. (to Gulf Oil Corp.). US Patent 3,971,636. 27 Jul 1976. vp.

Gulf Oil Corp.'s nonpolluting coal gasification process uses recycled water to recover pollutants for reuse. The process utilizes water vapor condensed out of the gasifier product stream to scrub char and pollutants from the same product stream, forming a slurry which can then be used as fuel in the combustion zone.

54300 Problems in underground coal gasification. Pirklblauer, S. *Erdoel-Erdgas Z.;* **92**: 175-180(Jun 1976). (In German).

Austria's SAKOG reviews the methods and problems of underground coal gasification and its possible application in Austria. Because of depth or geological conditions, some 90% of the world's coal reserves is not economical to produce using conventional techniques. At the present time, the U.S. has three in situ gasification projects under way, with a fourth in the initial stages. Of eight projects in the U.S.S.R., three are in commercial operation. There are basically four different processes: the Longwall Generator, the Linked Vertical Wells, the Thick Packed Bed, and the Steeply Dipping Bed concepts. The major technological criteria involved in in situ coal gasification include (1) chemical and physical reactions, (2) measuring technology, (3) permeability, (4) rock mechanics, (5) environmental effects, (6) leakages, (7) yield, (8) efficiency, (9) by-products, (10) drilling technology, and (11) health and safety considerations.

54301 Bibliography of literature pertinent to the gasification project at CRE. Robson, B. London; Coal Research Establishment (1975). vp.

This is a collection of literature references relevant to the current project on gasification for power generation. It therefore covers the subjects of gasification and combined cycles and takes in the essential topics of solids handling and gas cleaning. There is also a section on relevant symposia and meetings. The review is in no sense exhaustive or comprehensive, but should form a useful introduction to the project. The subjects of underground gasification, hydrogasification, methanation and substitute natural gas are excluded.

LIQUEFACTION

REFER ALSO TO CITATION(S) 54226, 54259, 54268, 54272, 54274, 54275, 54277, 54278, 54284, 54291, 54294, 54793, 55289, 55384

54302 (EPRI-AF—780) **Short residence time coal liquefaction. Final report.** Longanbach, J.R.; Droege, J.R.; Chauhan, S.P. (Battelle Columbus Labs., OH (USA)). Jun 1978. 71p. Dep. NTIS, PC A04/MF A01.

Coal liquefaction at short residence time was investigated using a laboratory-scale reactor. West Kentucky 9/14 coal and recycle solvent from the Wilsonville SRC pilot plant were used. The effects of temperature, pressure, solvent/coal ratio, and residence time on the initial dissolution were studied. Results were also obtained using added high pressure molecular hydrogen and tetralin. Conversion to nominally tetrahydrofuran-soluble products was rapid but reversible in the absence of an effective hydrogen-donating solvent. THF soluble conversion was increased in the presence of tetralin. Yields of SRC were commonly greater than 100%, probably due to the presence of solvent in the SRC fraction. An average of 12% of the organic sulfur and all of the inorganic sulfur were removed from the starting coal. This study demonstrated that West Kentucky 9/14 bituminous coal can be converted to a sufficient extent to be of commercial interest at short residence time and under reasonable operating conditions. However, solvent incorporation into the heavy SRC type product was substantial. Based on these and other recent results, it was concluded that further work on short residence time coal conversion, including a subsequent upgrading step, is warranted.

54303 (FE—2007-45) **Filtration process and equipment studies for coal liquefaction processes. Quarterly report, December 1977—February 1978.** Smith, G.R.S.; Hodge, J.A. Jr. (Johns-Manville Sales Corp., Denver, CO (USA)). 14 Mar 1978. Contract EX-76-C-01-2007. 20p. Dep. NTIS, PC A02/MF A01.

Filtration runs resumed using in situ precoating with pressure instead of suction. Detail of the new precoating technique is described. Four series of filtration runs were made with Tacoma Filter Feed, but all were considered only partially successful because of precoat failure before completion. This was attributed to a high proportion of the precoat dropping off and allowing progressive blinding or plugging. Detailed observations of the precoat failures have been reported. Apparently, the precoat failures were associated with the new procedures and conditions being used for in situ precoating. Considerable attention has been given to analyzing the cause of these failures. It has been concluded that the most likely cause was due to flashing of the solvent used for pre-coating and/or precoating. This flashing could occur during the filtration step at 600°F. Flashing during filtering was not, however, a problem when precoating under vacuum. It is unlikely, therefore, that flashing

occurs during the filtration step once the precoat solvent has been purged from the precoat, by the filtered liquefied coal. Flashing could, of course, take place during this purging period. Special precoating experiments were performed to confirm this reasoning.

54304 (FE—2353-20(Vol.1)) **EDS coal liquefaction process development: Phase IIIA. Final technical progress report, January 1, 1976—June 30, 1977.** Fant, B.T. (Exxon Research and Engineering Co., Baytown, TX (USA). Baytown Research and Development Div.). Feb 1978. Contract EX-76-C-01-2353. 388p. Dep. NTIS, PC A17/MF A01.

This report is the Final Technical Progress Report for ERDA Contract No. E(49-18)-2353 for the EDS (Exxon Donor Solvent) Coal Liquefaction Process Development—Phase IIIA. The contract and this report covers the eighteen-month period January 1, 1976 through June 30, 1977. Funding is shared by ERDA, the Electric Power Research Institute, and Exxon Research and Engineering Company. This Final Report is presented in two volumes: volume I contains the Laboratory Process Research and Development contribution and includes Technical Reporting Categories 1 to 7 and the Appendices for these sections; volume II contains the Engineering Research and Development contribution and includes Technical Reporting Categories 8 to 11. Results are presented under eleven activities: operation of recycle coal liquefaction units; operation of the one ton per day liquefaction pilot plant; solvent hydrogenation studies; bench-scale units, modeling and correlation studies; product quality studies; coking and gasification studies; construction and operation of the 2 barrel per day coking/gasification pilot plant; commercial study design and cost estimate; cost reduction and laboratory guidance study; pyrolysis and gasification engineering studies; and engineering technology studies.

54305 (FE—2547-21) **Phase II laboratory support for H-Coal Project. Monthly progress report No. 21, June 1978.** Comolli, A.; Battista, C.; Bernard, R.; Johanson, E.; Karolkiewicz, W.; Rao, P.; Reynolds, M.; Weber, C. (Hydrocarbon Research, Inc., Lawrenceville, NJ (USA)). Jul 1978. Contract EF-77-C-01-2547. 42p. Dep. NTIS, PC A03/MF A01.

Analytical results and product distribution calculations on the Bench Unit runs to test denitrogenation and higher density catalysts have been updated. For the two nickel molybdate denitrogenation catalysts the residual oil nitrogen content was reduced from 1.7 W % to 1.45 W %, and the nitrogen content of the naphtha was reduced from 0.15—0.3% to 0.05—0.15% nitrogen. The difference between the two nickel catalysts in this respect is not significant. The Amocat 1A, cobalt molybdate catalyst, gave the best desulfurization (0.34 W % sulfur in the residual oil versus 0.46% in the standard HDS 1442A) and the best product structure. Further results of the Kentucky No. 11 coal evaluation test have been received and show that the Kentucky No. 11 is not equivalent to Illinois No. 6. The Kentucky coal gave a slightly higher proportion of total liquid and gaseous product; however, it was more difficult to convert to lighter oil products and to desulfurize. Based on this test data the fuel-oil mode for Kentucky No. 11 coal would be 50 to 60 lbs/hour/cubic foot versus 78 lbs/hour/cubic foot for Illinois No. 6. The PDU emergency procedure run will start in early August based on a current estimate of the work load remaining and manhours available. This is in response to less urgency on schedule and more emphasis on cost. Modifications to the PDU are nearing completion to simulate the Pilot Plant and to improve reliability and productivity. The oil-gas preheater combination burner and data acquisition system installations are complete.

54306 (FE—2893-7) **EDS coal liquefaction process development: Phase IIIB. Quarterly technical progress report, October 1—December 31, 1977.** Epperly, W.R. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Mar 1978. Contract EF-77-A-01-2893. 397p. Dep. NTIS (US Sales Only), PC A17/MF A01.

A process veriable study with Wyoming subbituminous coal in the 50 pound-per-day Recycle Coal Liquefaction Unit showed that Wyoming coal liquid yield at 840°F increases continually with increasing residence time. This is in contrast to liquid yield from Illinois No. 6 bituminous coal, which exhibits a maximum within the same broad range of residence time. Liquid yield data and residual bottoms viscosity considerations strongly suggest that the optimum space time for liquefying Wyoming coal at 840°F is between 4.83 x RV and 7.25 x RV. Within this range of space time, the liquid yield is nearly constant, and the residual bottoms viscosity is sufficiently low to permit easy bottoms handling. At 880°F liquefaction temperature is essentially equal to the maximum liquid yield at 840°F but it can be obtained with at least a two-fold reduction in the residence time. An empirical model for liquefaction of Wyodak subbituminous coal was completed. Improved modeling of the solvent hydrotreating process was achieved by including additional compounds in a molecular accounting of the donatable hydrogen content. A combustion test of a 50 horsepower Cleaver-Brooks industrial boiler showed that coal liquids burn with less smoke and lower particulates formation than petroleum fuel oils. Nitrogen oxides produced in the combustion test were at levels expected from the nitrogen content. A process variable study was initiated to obtain the necessary data for the development of a kinetic model for the gasification of coke in the FLEXICOKING process. A three-month run in the Integrated Coking/Gasification Pilot Plant was completed. Results indicate that EDS coke particle integrity is good, and that up to 70% ash-free coke gasification is possible.

54307 (ORNL/TM—6379) **Analysis of Blind Flange and Thermowell Assembly from Wilsonville, Alabama, Solvent Refined Coal Plant dissolver tank.** DeVan, J.H.; Leslie, B.C.; King, R.T. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

A type 316 stainless steel blind flange and thermowell assembly rated at 17 MPa (2500 psi) was removed from service at the Wilsonville Solvent Refined Coal (SRC) plant when cracks were observed on the flange face. Metallographic examination revealed a system of cracks that penetrated a repair weld and extended into the base metal on the face where it was exposed to the process media. The cracking in the weld metal appeared to follow substructural boundaries. A second crack network initiated in the disturbed base metal beneath a ground surface and extended through a tenth of the flange thickness. Cracking in the base metal was transgranular. Neither the corroding species nor the local stress level responsible for the cracking can be specified.

54308 (SAND—78-0634) **Mineral matter effects and catalyst characterization in coal liquefaction. Project No. 8008 first quarterly report, October—December 1977.** Granoff, B.; Thomas, M.G. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 26p. Dep. NTIS, PC A03/MF A01.

This is the first quarterly report of a study of mineral matter effects and catalyst characterization in coal liquefaction. The objectives of the program are to: (1) determine the effect of mineral content on coal liquefaction kinetics and product composition and (2) analyze catalysts that have been tested in a bench-scale, continuous reactor. To study the effects of mineral matter on coal hydroliquefaction, an existing one-litre, stirred, high-pressure (5000-psig maximum allowable working pressure) autoclave was modified for rapid heating and cooling of a coal/solvent slurry. Residence times as short as one minute are possible at operating temperatures (depending on the solvent used) to 435°C and operating pressures of 2000 psig. One hot (405°C) and six cold (22°C) slurry injection experiments have been completed, with Illinois No. 6 coal (Burning Star Mine; 11.8 percent ash and 3.5 percent sulfur) in tetralin (1, 2, 3, 4-tetrahydronaphthalene) solvent. In each case, at least 85 to 95 percent of the coal slurry had been injected into the preheated solvent. Product workup and analysis techniques, using room temperature pressure filtration for solids removal, vacuum distillation, and Soxhlet extractions with tetrahydrofuran, benzene, and pentane, have been evaluated. Fresh and spent samples of the current H-Coal catalyst (American Cyanamid, 1442A) have been received from Hydrocarbon Research, Inc. These will be analyzed for Fe and Ti by emission spectroscopy. Elemental-depth profiling of these metals will be accomplished by electron microprobe analysis.

54309 **Coal liquefaction product deashing process.** Gorin, E. (to Continental Oil Co.). US Patent 4,094,766. 13 Jun 1978. Filed date 1 Feb 1977. 4p.

Liquefaction of coal is effected by extraction of coal by a distillable solvent in the presence of hydrogen under conditions selected to produce a coal liquefaction product, the major portion of which is distillable. The effluent slurry product is vacuum distilled to recover the distillables including the solvent. The bottoms fraction is subjected to solvent treatment or fractionation to selectively recover the lower molecular weight portion, which portion is hydrogenated to yield distillate fuels. The remainder of the bottoms fraction is used as feed to a gasifier to make a hydrogen-rich gas or a methane-rich gas as desired.

54310 **Coal liquefaction process.** Bearden, R. Jr.; Aldridge, C.L. (to Exxon Research and Engineers Co.). US Patent 4,094,765. 13 Jun 1978. Filed date 17 Dec 1976. 6p.

A coal liquefaction chargestock is first treated with a hydrogen sulfide-containing gas and thereafter subjected to coal liquefaction conditions. It has been found that pretreatment of the coal liquefaction feed with a hydrogen sulfide-containing gas gives improved coal liquefaction results such as coke suppression and an increase of liquid yield.

54311 **Molten salt hydroconversion process.** Heredy, L.A. (to Rockwell International Corp.). US Patent 4,092,236. 30 May 1978. Filed date 30 Aug 1976. 12p.

Hydrocarbonaceous materials such as petroleum residuums, coal, lignite or the like are introduced into a molten salt bath maintained in a reaction zone at elevated temperature and pressure. Hydrogen also is introduced into the reaction zone in an amount sufficient to provide a pressure in the reaction zone within the range

of from about 30 to 400 atmospheres. The hydrocarbonaceous material is reacted for a time sufficient to produce cracked products including a major amount of liquid and a minor amount of gaseous and solid products of enriched hydrogen content. The molten salt bath comprises at least one alkali metal hydroxide which preferably is sodium hydroxide. Substantially all of the sulfur and ash constituents of the hydrocarbonaceous material are retained in the molten salt. When the hydrocarbonaceous material is a normally solid material such as coal, it advantageously is crushed and slurried in an organic hydrogen donor solvent prior to its introduction into the molten salt bath.

54312 Treatment of coal by alkylation or acylation to increase liquid products from coal liquefaction. Schlosberg, R.H.; Maa, P.S.; Neavel, R.C. (to Exxon Research and Engineering Co.). US Patent 4,092,235. 30 May 1978. Filed date 26 Nov 1975. 14p.

The production of liquid hydrocarbons from coal is significantly enhanced by alkylating or acylating the coal prior to subjecting the coal to liquefaction conditions. The introduction of aliphatic hydrocarbon radicals or acyl radicals, including carbon monoxide, into the coal structure is believed to permit more of the coal to undergo liquefaction at suitable liquefaction conditions. The alkylation or acylation reactions can be conducted in the presence or absence of added or extraneous catalysts.

54313 Process for catalytic depolymerization of coal to liquid fuel. Moore, R.H.; Cox, J.L. (to Battelle Memorial Inst.). US Patent 4,090,944. 23 May 1978. Filed date 7 Sep 1976. 8p.

A process for the depolymerization of coal which includes contacting coal with phenol and a Bronsted acid catalyst at elevated temperatures and pressures for a period of about 5 minutes. The liquid coal extract which results from this process can be subjected to hydrogenolysis to produce a liquid hydrocarbonaceous product oil.

54314 Coal liquefaction and national needs. Given, P.H. *Earth Miner. Sci.;* **47**: No. 8, 57-60(May 1978).

A number of processes for converting coals to pumpable, low-sulfur fuel are at the pilot plant stage. Increasing emphasis is being placed on the Gulf Oil Company's Solvent Refined Coal process which uses no added catalyst, and the Exxon Donor Solvent process, in which only a distilled recycle oil is treated catalytically (inorganic constituents of coals, like titanium, which can poison catalysts, are not present in distilled products). Crude liquefaction products contain some unhydrogenated solid organic matter and the mineral matter originally present in the coal. It is highly desirable to remove as much of this solid matter as possible. Many properties of coals are significant in determining the level of conversion, the distillability and composition of the products, and the amount and nature of a gaseous by-product. A systematic study is in progress to elucidate these various relationships and to establish quantitative means of predicting coal behavior to the extent that this is feasible. The contents of sulfur, reactive macerals, and organic carbon have been found to be significant.

54315 Inherent mineral matter in coal and its effect upon hydrogenation. Gray, D. (Fuel Research Inst. of South Africa, Pretoria). *Fuel;* **57**: 213-216(Apr 1978).

The problems associated with assessing the catalytic effects of inherent mineral matter in coal during hydrogenation are discussed in detail. Preliminary results obtained from various relative density fractions of a South African high-mineral-matter coal are reported. Inert matter has been added in an attempt to minimize the complicating effects of agglomeration of the coal particles in order to gain a greater understanding of the relative importance of maceral versus mineral content of the coal during hydrogenation. It is difficult to determine any "catalytic effect" of mineral matter in coal during hydrogenation since the mineral matter appears to be acting in a physical capacity as an internal diluent, reducing agglomeration of the coal particles. This decrease in agglomeration allows more effective diffusion of hydrogen to the sites of bond rupture and products away from the coal particles as well as maintaining a higher overall surface area for reaction.

54316 Problem of uncertain oil supplies. Quinlan, M. *Pet. Econ.;* **45**: No. 2, 56-58(Feb 1978).

This article discusses the Sasol I plant in South Africa, which uses both the fixed-bed and the fluidized-bed Fischer-Tropsch process to produce liquid fuels from coal. The product distribution from these two processes is given. The process is said to be commercially viable, but this must be due to the low price of coal in South Africa. Established coal reserves are thought to be 12000 to 20000 million tonnes. Other aspects of the South African energy situation are also discussed.

54317 Oil from coal plant in race to beat sanctions. Spring, M. *Process Eng.;* 61(Feb 1978).

Brief details are given of the Sasol 2 plant, which will use the Synthol process to produce 1.5 M tonnes of liquid fuels per year, plus 165,000 t/a of ethylene, 15,000 t/a of ammonia, 90,000 t/a of creosote, 60,000 t/a of pitch, and sulphur and crude tar acids.

54318 Catalytic hydrosolvation process converts coal to low-sulfur liquid. Qader, S.A. (Jet Propulsion Lab., Pasadena, CA). *Energy Sources;* **3**: No. 3/4, 323-337(1978).

Development of the catalytic hydrosolvation process for converting coal to low-sulfur fuel oil is described in this paper. Coal impregnated with catalyst was slurried with oil, and the mixture was hydrogenated at a temperature of 475°C and 30 min residence time under 3600 psi pressure. A ton of coal yielded 3.5 bbl of fuel oil containing 0.2% sulfur, with naphtha and C_1-C_4 hydrocarbon gases as byproducts. A preliminary economic evaluation of the process indicated potential for further development.

54319 Hydrodesulfurization and liquefaction of a bituminous coal in a batch autoclave with particulate and monolith catalysts. Scinta, J. Buffalo; State Univ. of New York (1978). 190p. University Microfilms Order No. 78-10,662.

Thesis (Ph. D.).

Batch autoclave experiments were conducted to study the hydrodesulfurization and liquefaction of a bituminous coal. The experiments were divided into two studies: (1) a 2^3 factorial design to investigate the principal effects and interactions of catalyst pore diameter (100 A and 200 A), catalyst presulfiding (presulfided or not presulfided), and autoclave stirring rate (250 rpm and 500 rpm); and (2) a series of duplicate experiments to study the effects of three novel cobalt—molybdate monolith catalysts. Only sulfiding and the interactions of the other factors with sulfiding appeared to have an effect on product distribution. Further analysis of the data as two 2^2 factorial designs indicated that each of the factors had a significant effect on product distribution, although in a contrasting manner. To maximize oil production, either the 100 A catalyst should be used presulfided at a stirring rate of 500 rpm or the 200 A catalyst should be used not sulfided at 250 rpm. All of the experiments produced a pitch (oil + asphaltene) with a much lower sulfur level than the 4.3% in the original coal. Pitch from runs with no catalyst had a sulfur content of about 0.65%, while the particulate and monolith catalyst experiments yielded pitches with sulfur contents of about 0.5% and 0.45%, respectively. The oils were resolved into about forty components. These components probably included methylnaphthalene, fluorene, other polycyclic aromatics and straight chain hydrocarbons such as tetradecane and eicosane. While the chromatograms were similar qualitatively, the quantitative oil composition varied among the catalysts.

54320 Coal conversion: a review. Gray, D.; Barrass, G. (Fuel Research Inst., Pretoria). *Chemsa;* **3**: No. 6, vp(Jun 1977).

Four major methods of coal liquefaction are reviewed briefly: pyrolysis, solvent extraction, (gasification, shift process and Fischer-Tropsch synthesis), and direct hydrogenation in a hot, pressurized oil slurry using catalysts. Direct hydrogenation provides the highest yields (up to 47%). Future research effort is recommended as follows: on the structure of coals and on the chemical processes involved in conversion, on catalysts which optimize liquid yields and are resistant to poisoning by nitrogen, sulfur and mineral matter, on the upgrading of coal-derived liquids to gasoline, diesel fuels and fuel oils, and on possible environmental, toxic and carcinogenic effects of coal liquids. The paper contains a good explanation of coal structure as now generally accepted. (LTN)

54321 Liquid products from coal. Krischko, A.A. *Khim. Tverd. Topl.;* No. 3, 144-149(May 1977). (In Russian).

Article reviews progress in various countries and discusses a Russian method of coal hydrogenation which uses a coal product as a hydrogen donor together with an organic additive and a catalyst. Coal is liquified at 100 atmos, and the yield of liquid product is 85 to 95%.

54322 Production of solvent refined coal. Chakraborty, M.; Sarkar, S. *J. Mines, Met. Fuels;* **25**: No. 5, 139-144(May 1977).

Work done in various countries on solvent refined coal is reviewed, including that at the Indian Central Fuel Research Institute. Potential uses of SRC for electrode carbon, hydrogenation to oil, high energy fuel which could be used for power generation, gasification, MHD generation, fuel cells, etc., are discussed. The technology of refining of coal by dissolution could be applied to mining certain reactive coals: the coal would be partly dissolved and transported to the surface in a liquid which included water.

PYROLYSIS AND CRACKING

REFER ALSO TO CITATION(S) 54259, 54284

54323 (BNL—50779) Flash hydropyrolysis of coal. Quarterly report No. 3, July 1, 1977—September 30, 1977. Steinberg, M.;

Fallon, P. (Brookhaven National Lab., Upton, NY (USA)). Oct 1977. Contract EY-76-C-02-0016. 60p. Dep. NTIS, PC A04/MF A01.

The program is designed to study the process variables and chemistry of the Flash Hydropyrolysis Process, a rapid gas-phase, non-catalytic coal hydrogenation technique developed at BNL. The equipment used is a 1 lb/hr unit utilizing a 1 inch down flow tubular reactor designed to operate at up to 4000 psi and 800°C. This equipment has been in operation for more than a year with only one problem. All the data to date on product yield as a function of temperature and hydrogen pressure is correlated in 4 tables and plotted in a series of 9 figures. The total liquid yields appear to reach a maximum of approximately 20% at 750°C with only slight increase with hydrogen pressures above 2000 psi. Approximaly half of this yield is BTX. The ethane yield also appears to maximize between 700 and 750°C but continues to increase with increased pressure. Methane yields are shown to continue to increase with both temperature and hydrogen pressure. Total carbon conversion under these conditions approximated 60%. The pyrolysis of lignite using helium in the system shows a five to ten fold decrease in the yields of CH_4, C_2H_6 and C_6H_6 compared to flash hydropyrolysis under hydrogen pressure. Preliminary experiments were conducted at 750 and 800°C to determine the effect of coal particle residence time on product yields and distribution. The results indicate that at 750°C both liquid and gaseous yields increase from 45% to 52% as the residence time is increased by a factor of four from 2.3 to 9.2 seconds. However, at 800°C under similar conditions, little change in total yield (60%) is observed but the liquid yield decreases from approximately 4% to 1% with a corresponding increase in gaseous products.

54324 (MIT/2295/T26—2) **Basic studies of coal pyrolysis and hydrogasification. Semi-annual progress report, January 1—June 30, 1977.** Bush, T.W.; Howard, J.B.; Kenda, S.; Mead, D.; Peters, W.A.; Suuberg, E.M. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1977. Contract EX-76-A-01-2295-026. 60p. Dep. NTIS, PC A04/MF A01.

Systematic studies of compositions and rates of formation of products from the pyrolysis and hydropyrolysis of a partially dried Montana lignite and a Pittsburgh Seam bituminous coal are being performed under independently controlled conditions pertinent to practical interest, including heating rates (65—12,000°C/s), pressures (0—100 atm of hydrogen, helium and mixtures thereof), final temperatures (400—1100°C), and particle sizes (5—1000μm), using small-scale batch and entrained flow reactors. Applicability of the batch system to high-pressure conditions was confirmed, while shakedown testing of the flow reactor demonstrated that its performance was very sensitive to the size and configuration of the coal feeder, reaction chamber, and product collector. Although preliminary tar and weight loss data for bituminous coal were comparable to results from the batch reactor, an extensive overhaul of the flow reactor was needed. Systematic studies of lignite hydropyrolysis, and bituminous coal pyrolysis, as well as several bituminous coal hydropyrolysis, runs were performed in the batch reactor. Hydrogen in short residence times at 69 atm exerts an effect on methane yields from both lignite and bituminous coal at temperatures below 600°C, but has little effect on total conversions of lignite until 750°C or of bituminous coal up to 1000°C. The principal volatile products from bituminous coal pyrolysis are gaseous hydrocarbons, tars, and liquids with only small yields of carbon oxides. Mass transfer resistance exerts a large effect on product compositions from bituminous coal pyrolysis while reaction temperature, time, and hydrogen partial pressure may be manipulated to direct methane and total volatile yields from both coals.

54325 Fresh light on the thermal destruction products of caking coal. Belov, K.A. *Khim. Tverd. Topl.;* No. 3, 127-132(May 1977). (In Russian).

The composition and properties of the solid products obtained under various conditions of thermal destruction are reported.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 54239

54326 Obtaining purified anthracene from coke based chemical feedstock. Kuznetsova, L.S. *Koks Khim.;* No. 1, 38-40(Jan 1978). (In Russian).

Crude anthracene was dissolved in acetone under pressure to provide a 96% pure product. (In Russian)

54327 Alternative coal firing methods for indurating iron ore pellets. Nigro, J.C. (Twin Cities Metallurgy Research Center, MN). pp 33p, Set No. 14, Paper 1 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

The National need to insure an uninterrupted supply of iron ore pellets in the face of a threatened cutoff of natural gas and oil as fuel for iron ore pelletizing has spurred research to determine the effectiveness of coal as an alternative fuel. Similar studies also are being conducted by industry. Several methods of utilizing pulverized coal for firing the three types of pelletizing furnaces are discussed. Tests have demonstrated that high-ash-fusion-temperature, Eastern bituminous coals can probably be utilized satisfactorily but that it is questionable whether the more economical Western subbituminous coals can be used because of potential ringing problems. Pellet contamination by coal ash does not appear to be a serious problem. A coal firing concept based on external combustion chambers will undoubtedly be best for firing the straight grate of shaft furnace since both systems require hot gases for pellet induration. Although excellent combustion of pulverized coal has been achieved in pilot plant scale refractory insulated chambers, slag erosion of the refractory lining resulting in increased slag viscosities and difficulties in slag tapping are potential problem areas. Pilot plant tests employing a pulverized-coal-fired, cyclonic slagging burner to fire a mockup shaft pelletizing furnace combustion chamber and bustle demonstrated the necessity of using a coal with an ash fluid temperature below the 2,350°F bustle temperature to avoid blockage of the inaccessible flues, ports, and other refractory passageways. The additional problem of distributing powdered coal to a multiplicity of small combustion chambers appears to make the shaft pelletizing operations the least adaptable to direct coal firing.

PROPERTIES

REFER ALSO TO CITATION(S) 54232, 54233, 54237, 54252, 54272, 54314, 54325, 54489, 54938

54328 (ORNL/MIT—270) **Surface properties and reactions of coal, Part 2.** Field, L.A.; Papadopoulos, A.J.; Wang, R.D. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). 28 Mar 1978. Contract W-7405-ENG-26. 34p. Dep. NTIS, PC A03/MF A01.

Studies were done on high-volatile, A-bituminous coal that has been stored under inert atmosphere and ground in liquid. After outgassing at room temperature for 16 hr, Brunauer-Emmett-Teller (BET) surface areas were 3.5 m^2/gm coal for N_2 at -196°C, 161.1 for CO_2 at -78°C, and 52.5 for H_2O at 0°C. Following H_2O sorption, the N_2 area increased to 6.5 m^2. Outgassing at 134°C for 19 hr led to surface areas of 9.67 (N_2), 161.2 (CO_2), and 43.6 (H_2O) m^2/gm coal. Species with molecular weights in the range 40 to 130 were evolved on outgassing at temperatures above 100°C. H_2O, CO_2, and CO (or N_2) were the major species evolved at all temperatures. Weight loss was proportional to sample mass (0.0359 gm/gm coal) at all temperatures. Heats of immersion in water decreased from 30 to 15 J/gm for OGTs from 25 to 220°C and reached its final value within 60 min of outgassing at 25°C. Energies and entropies of adsorption and kinetics of gas evolution were studied.

54329 Determination of the air permeability of coke. Sukorokov, V.I. *Koks Khim.;* No. 1, 21-23(Jan 1978). (In Russian).

Air permeability can provide valuable information on coke pore structure. A method for its determination is described. Test results showed that increasing the gas-coal content in the coking charge raises permeability. The degree of permeability is mainly governed by the shape and size of the pores rather than by their aggregated surface area. (In Russian)

54330 Characterization of nitrogen compounds in tar produced from underground coal gasification. King, S.B.; Brandenburg, C.F.; Lanum, W.J. (Laramie Energy Research Center, WY). *Energy Sources;* 3: No. 3/4, 263-275(1978).

Although the major product of underground gasification of coal is a low-Btu gas, approximately 5 percent of the total energy produced is in the form of relatively low-boiling coal tars. These liquid organic compounds, which are produced along with water and the product gas, have been characterized for their potential use as a synthetic liquid fuel. The liquids may also be suitable as a petrochemical feedstock and useful in determining the chemical reactions that are occurring underground. The coal tar material, which was sampled regularly during an underground coal-gasification test, showed variations in boiling ranges of from ambient to 600°F and ambient to 950°F with little or no residue as determined by simulated distillation. The coal tars were separated into tar acid, tar base, and neutral oil fractions. Of particular interest was the tar base fraction, which was examined in detail and showed the major constituents to be nitrogen-containing alkyl pyridines. The specific identification of several pyridines and the relative concentrations of these compounds produced under varying gasification conditions are

discussed. Virtually all the nitrogen-containing compounds are weak bases as shown by potentiometric titration. The sulfur content of the acidic, basic, and neutral fractions is 0.2 to 0.3 percent.

54331 Distribution of minor elements in the miocene coals of the Keelung-Taipei Region, Taiwan. II. Mineral matter and trace elements. Youh, C.C. (National Taiwan Univ., Taipei). *Proc. Natl. Sci. Counc., Repub. China;* **1**: No. 11, 27-39(10 Oct 1977).

A complete study of the minor and trace elements distribution of seventeen Miocene coals from four coal-bearing formations of the Keelung-Taipei region is made. From the results of chemical and X-ray analyses of the investigated coal ashes, the most possible mineral matter in the coals are hydrated aluminosilicates, quartz, carbonates and iron disulfides. Most trace elements are studied by emission spectrography whereas uranium, molybdenum, titanium and manganese are determined with wet colorimetric method by using the coal ashes as analytical sample. Chlorine is studied with gravimetric determination by using the whole coal as sample. Among them, titanium, boron, manganese, barium, chlorine together with organic sulfur and phosphorus are good pathfinder elements for differentiating coal-bearing formations. Furthermore, boron is greatly enriched in the investigated coal ashes in comparison with that of average crustal abundance while germanium, beryllium and bismuth are randomly distributed. 7 tables.

54332 Electrochemical method of determining reducibility. Lapin, A.A. *Khim. Tverd. Topl.;* No. 5, 37-43(Sep 1977). (In Russian).

The reducibility of coal can be determined by measuring the oxidation reaction at an anode and the reducing reaction at the cathode of an electrochemical cell. The method should be useful in the genetic classification of coal.

54333 Reflectance as a vital characteristic. Dobronravov, V.F.; Romanovskaya, M.V. *Khim. Tverd. Topl.;* No. 5, 66-72(Sep 1977). (In Russian).

Article discusses the relationship between the values obtained when measuring the volumetric reflectance of vitrinite in air and when immersed. For medium rank coals, there is a constant ratio between the reflectance and refraction.

54334 Fresh light on spontaneous combustion. Kizil'shteyn, L.Ya.; Kosnskij, V.A.; Shelepin, O.E. *Khim. Tverd. Topl.;* No. 5, 107-112(Sep 1977). (In Russian).

This article suggests a possible relationship between the morphological varieties of sulfide encountered and the tendency of a coal to spontaneous combustion.

54335 State of, and trends in, coal petrology research. Eremin, I.E. *Khim. Tverd. Topl.;* No. 3, 63-69(May 1977). (In Russian).

Recent achievements in coal petrology include standardization of methods of petrographic examination, the study of the composition and properties of the individual microcomponents, and the prediction of cokeability and other properties. The development of the standard industrial and genetic classification of coals used in the USSR is considered.

54336 Physical properties and structure of anthracites. Posylnyi, V.Ya. *Khim. Tverd. Topl.;* No. 3, 24-28(May 1977). (In Russian).

The physical properties of coarse specimens of anthracite are dictated by the orientation of the laminar and fissure patterns present. In smaller regions, there is clear anisotropy caused by the orientation of the linear parts of the macro-molecule. The content of aromatic lattices and graphitoids is not directly connected with rank.

54337 Macromolecular structure of coals and their technological properties. Shapiro, M.D.; Alterman, L.S. *Khim. Tverd. Topl.;* No. 3, 17-23(May 1977). (In Russian).

Results of research into the technological properties of coal in the light of macromolecular and supramolecular structure of the coals are summarized. The presence of amorphous linear macromolecules may explain some regular patterns observed in fuel technology.

54338 Kukharenko, T.A. (Oxidation mechanism and molecular structure of brown and lean coals). *Khim. Tverd. Topl.;* No. 3, 70-77(May 1977). (In Russian).

This paper emphasizes the hydrolytic character of coal oxidation under various conditions. There are differences at various stages of the oxidation process between brown and lean coal. Factors influencing the reactivity of coal are discussed.

54339 Coal oxidation kinetics and accompanying chemiluminescence. Kucker, R.P. *Khim. Tverd. Topl.;* No. 3, 88-93(May 1977). (In Russian).

The accumulation of paramagnetic particles, peroxides, carboxylic, phenolic and carbonyl groups, during the oxidation of coals at 150C was studied; the accumulation of peroxides during oxidation at various temperatures was also investigated. The maximum peroxide content increases with oxidation temperature, apparently because of the increase in pore volume within the coal mass at elevated temperature. The kinetics involved in the chemiluminescence which accompanies isothermal oxidation of coals is discussed, and an equation is presented which describes the diminishing intensity of light emission. A mechanism is suggested to explain the formation of excited particles.

54340 Rational parameter underlying the genetic and industrial classification of coal. Lapin, A.A.; Pereverzev, G.A. *Khim. Tverd. Topl.;* No. 3, 57-62(May 1977). (In Russian).

The classification parameter suggested is the reducibility determined directly by electrochemical methods. The best way of classifying anthracite is to use the critical intensity of the electrical field determined by recording the volt-ampere characteristic of solid specimens. In combination with the rank, this can be used to select anthracite suitable for refractory graphite.

54341 First results obtained with the ISO combined (MICUM-IRSID) test on coke over 20 mm in size. Vanpoulle, A. *Cent. Doc. Sider. Circ. Inf. Tech.;* No. 10, 2127-2136(1977). (In French).

This ISO test is made on a 50 kg sample of coke over 20 mm in size. The test is interrupted after 100 drum revolutions, and the M10, M20 and M40 indices are determined (as in the MICUM test). The test continues during a further 400 revolutions in order to obtain the I10, I20 and I40 indices. No systematic pattern changes were revealed by the classic IRSID tests during three measuring programmes carried out on coke at the coke oven outlet, nor on coke from blast furnace accumulator outlets.

54342 Universal classification for coals. Mianowski, R. *Cent. Doc. Sider. Circ. Inf. Tech.;* No. 9, 1869-1872(1977). (In French).

Conclusions from an interim report drawn up by the Soviet delegate regarding the present international classification of coals adopted by the CEI. Comments on these conclusions. Advantage of proposed solution in a new universal classification: Use of vitrinite reflectance as a parameter of rank, and use of inertinite value as a parameter of facies. Classification could be completed by use of specific parameters for a given application. A system proposed by a British expert for classifying coking coals is discussed.

54343 Calorific value of coals and cokes. Leyendecker, G. *Cent. Doc. Sider. Circ. Inf. Tech.;* No. 1, 23-32(1977). (In French).

This paper deals in depth with the fixing of calorific values of coals and cokes, and especially with the Higher Calorific Value defined in NFM standard 03-005. Calculation of HCV on dry and on pure coal (taking into consideration mineral matter content) and Lower Calorific Value. Discusses the relation between HCV and other characteristics: degree of coalification, volatile matter index, carbon and oxygen content. The influence of hydrogen content, of the degree in organization of carbon, of volatile matter index, etc., on the calorific values of cokes is considered.

54344 Blend studies on behalf of the British Steel Corporation (Scottish Division). London; British Carbonization Research Association (1977). 51p.

The introduction of a more stringent strength specification for the coke made by the Scottish Division of the British Steel Corporation and the possible future dearth of indigenous Scottish coals stimulated 17-t, 350-kg and 250-kg-oven studies on the evaluation of coals (Scottish and imported) and blends for coke-making. Included in the studies were the evaluation of individual Scottish coals, the effects of adding poorer coals (unbriquetted and briquetted) to the Scottish blend and the evaluation of blends containing imported low- and medium-volatile coals. On the basis of the results, imported coals have been selected for future incorporation in the Scottish blend and the compositions of suitable blends to produce high-strength cokes have been established.

54345 Tensile strength of rocks subjected to explosive loading. Khanakaev, A.N. *Sov. Min. Sci. (Engl. Transl.);* **12**: No. 3, 283-285(May 1976).

Rods of rectangular cross-section were fractured in tension by the reflection of a compression pulse created by explosive loading of the other end of the rod. The parameters of the pulse and the dimensions of the detached fragments were determined for diabase, granite, limestone, marble, combustible shale and coal.

54346 Determination of the mineral content of coals by direct and indirect methods. Takacs, G.; Kovatsits, k. *Publ. Hung. Min. Res. Inst.;* No. 19, 207-212(1976). (In German).

This paper discusses in detail the solution process used in the indirect method, and the extent to which compounds dissolve. The direct method described is that of oxidation by hydrogen peroxide. The errors of the two methods are compared. The chief advantage of the direct method is that the final product of the determination is the mineral matter itself, which is thus available for subsequent x-ray diffraction analysis.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 54247, 54248, 55396

54347 (FE—2549-15) **Development of potential uses for the residue from fluidized bed combustion processes. Quarterly technical progress report.** Minnick, L.J. (Minnick (L.J.), Inc., Plymouth Meeting, PA (USA)). Feb 1978. Contract EF-77-C-01-2549. 35p. Dep. NTIS, PC A03/MF A01.

Analyses of FBC residues from different installations indicate basic similarities in the range of particle size distribution of spent bed materials, with the exception of the Battelle residue, which is extremely fine-grained. There are, however, some notable differences in the chemical compositions of FBC residues from various sources. Hydration to a dry or wet end point is an effective means of concentrating the lime in the finer fractions of FBC residue. Stabilized road base compositions containing FBC residue and pulverized coal fly ash are capable of developing a substantial amount of compressive strength at relatively low curing temperatures, including impressive strength gains after only one week of curing at below freezing conditions. The durability of these compositions far exceed minimum specification requirements and exhibit considerably higher strengths after vacuum saturation than conventional formulations. While FBC residue does not appear to substantially reduce the plasticity of clay soil, moderate additions do result in significant strength additions to the soil. By proper proportioning of FBC residue and pulverized coal fly ash, concrete masonry units can be produced which are superior, in most respects, to conventional concrete block. Substitution of a portion of the cement used in block manufacture with FBC residue also enhances the economic attractiveness of FBC materials for such use. The cementitious properties of FBC residue/fly ash blends suggest the possibility for cement substitute in portland cement concrete mixtures. Early test results indicate that little in the way of harmful environmental effects can be expected from compositions containing FBC residue, particularly if the material is stabilized with fly ash.

54348 (FHWA-RD—77-136) **Evaluation of sulfate-bearing waste material from fluidized bed combustion of coals for soil stabilization. Final report.** Nebgen, J.W.; Edwards, J.G.; Conway, D. (Midwest Research Inst., Kansas City, MO (USA)). Sep 1977. Contract EX-76-A-01-2491. 70p. Dep. NTIS, PC A04/MF A01.

The effects of spent bed material from the fluidized bed combustion of coal in the physical and strength properties of selected fine-grained soils has been evaluated. The spent bed material is a mixture of lime and calcium sulfate (together with some fly ash) obtained from a process being evaluated by the Energy Research and Development Administration in which pulverized coal is burned in a fluid bed of finely ground calcitic or dolomitic limestone. Results of the study indicate that spent bed material is an excellent substitute for lime for soil stabilization. The material behaves as a mixture of lime, calcium sulfate, and fly ash toward development of unconfined compression strength when mixed with soils. It has been concluded that use of spent bed material for soil stabilization is a viable alternative to disposal when full-scale fluidized bed coal combustion plants become a reality.

54349 **In search of lost coal.** *Presence;* No. 6, 9-10(Jul 1977). (In French).

This paper discusses the spoil heaps belonging to Houilleres du Nord et du Pas-de-Calais which can be considered almost as a new coal deposit. The size and extent of these pit tips are discussed and their uses as building materials or as sources of heat are considered.

54350 **Plants for desulfurization and cleaning of waste and stack gases. The Saarberg-Hoelter process.** Esche, M. *Erdoel Kohle, Erdgas, Petrochem.;* **30**: No. 11, 511-514(1977). (In German).

The Saarberg-Hoelter lime-based flue gas desulfurization process has been used successfully in a 40 MW coal-fired power station, where it can remove 90 to 95% of the sulfur.

54351 **Device for catching and cleaning dust laden gases coming from the coke side of a coke oven.** Schulte, F. Jr.; Bender, M. (to Hartung, Kuhn und Co. Maschinenfabrik G.m.b.H.). German(FRG) Patent 2,505,263/A/. 14 Aug 1975. 29p. (In German).

The main bulk of the dust is extracted by a suction hood, which covers the range of the coke cake falling and impinging on the watering car, which is appreciably greater than the length of the watering car. Several Venturi steam dust extractors are connected to the suction hood. The suction hood and Venturi steam dust extractors are fitted to a gantry which bridges the track of the watering car, and is movably supported on the main track and on the side of the watering car track away from the coking oven. A second extraction hood sucks dirty gases in the area between the door opening of the furnace chamber and the watering car. It is arranged so that even those dust laden gases can be extracted by it, which rise from an open adjacent furnace chamber. In those cases where the device according to the invention is to be used with coking ovens already in existence, the steam raising plant is fitted to a gantry. The inlet of fresh water and the outlet of slurry takes place in channels, which are laid parallel to the driving rail on the side of the watering car away from the furnace. To ease mainentance and repair, the suction hood consists of a lattice frame, whose openings can be covered by high grade steel plates which can be removed separately.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 54277, 54347, 54512, 54526, 55239, 55287, 55860, 55919

54352 (ANL/EES-CP—10) **Environmental control implications of increased coal utilization under the National Energy Plan.** Gottlieb, M.; Livengood, C.D.; Wilzbach, K.E. (Department of Energy, Washington, DC (USA). Div. of Environmental Control Technology; Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 18p. (CONF-780636—9). Dep. NTIS, PC A02/MF A01.

From 71. Air Pollution Control Association meeting; Houston, TX, USA (25 Jun 1978).

The increased use of coal to help satisfy domestic energy requirements has become a major facet of U.S. energy policy. The National Energy Plan of April, 1977 suggested a consumption goal of 1.2 billion tons of coal for 1985 as compared to a 1976 consumption of about 657 million tons. While the feasibility of such a goal has been widely debated, there is no doubt that coal use will increase markedly and that the development, selection, and use of proper environmental controls will be essential if environmental quality is to be preserved. Commitment to environmental goals is an integral part of the NEP. Whatever method of pollution control is chosen, the necessary degree of control required for adequate protection is, in principle, achievable at a cost. However, it is often not clear exactly what this degree of control should be. The complexity of the regulatory and control technology issues defies distillation into simplistic statements of fact. However, a few general conclusions are inescapable. Increased coal utilization will require the wider application of control measures and should stimulate the development of more cost-effective technologies. In the near term, compliance with regulations can generally be achieved by existing technologies, but only at the expense of higher costs for energy. Inasmuch as nearly all facets of the economy depend on energy to some degree, the secondary effects of these controls will impact on the entire population. In the longer term, compliance requirements may prove restrictive to growth unless more effective coal utilization control technologies are available. These considerations reinforce the need for standards setting and R and D program planning on a system-wide basis so that both direct and indirect tradeoffs can be considered. Both the costs and the benefits are far too important for anything less. (LTN)

54353 (ORAU—144) **Handbook for the development of terrestrial monitoring programs for coal mine reclamation.** Gist, C.S.; Clebsch, E.; McCord, R.; Wilkin, D.; Dietz, D. (Oak Ridge Associated Universities, Inc., TN (USA). Manpower Education, Research and Tranining Div.). Jul 1978. Contract EY-76-C-05-0033. 213p. Dep. NTIS, PC A10/MF A01.

Portions of document are illegible.

An overview of the need for definitive terrestrial monitoring program in surface coal mining is presented. The discussion emphasizes that although many aspects of air and water monitoring are defined by law, this is not the case in terrestrial monitoring. The use of decision theory in developing environmental monitoring, and the rationale for using DARE in that capacity is presented.

54354 (PB—276580) **Environmental assessment of low/medium Btu gasification. Annual report, March 1976—October 1977.** Cavanaugh, E.C.; Thomas, W.C. (Radian Corp., Austin, TX (USA)). Dec 1977. Contract EPA-68-02-2147. 35p. NTIS PC A03/MF A01.

The report summarizes completed and on-going work performed by Radian Corporation for the EPA in the area of environmental assessment of low- and medium-Btu gasification of coal and its utilization. Main areas discussed are the current process technology background, environmental data acquisition, and control technology assessment. Information presented gives a general understanding of what has been accomplished and what can be anticipated.

54355 **Emission sources and the situation with regard to the emission of cadmium in the Federal Republic of Germany.** Sartorius, R. *Staub-Reinhalt. Luft;* **37**: No. 11, 422-426(Nov 1977). (In German).

130 tons per year of cadmium is emitted from coal-fired installations in Germany, this being the largest single contribution to a total emission of 83.5 tons/year.

54356 Proposed regulations for reclamation of surface disturbed by deep mining. *Ky. Coal J.;* **3**: No. 8, 17-20(Aug 1977).

The purpose of this regulation is to provide for the reclamation of lands upon which surface disturbances have been or will be created by underground mining. In the preparation and enforcement of this regulation, the Kentucky Department for Natural Resources and Environmental Protection has the following goals incidental to underground mining: (a) The prevention of land erosion; and (b) The regulation in a fair and equitable manner of the reclamation of land disturbed or removed by activities resulting from or incident to a mine.

54357 Run-off and erosion characteristics of surface-mined sites in western North Dakota. Gilley, J.E. *Trans. ASAE (Am. Soc. Agric. Eng.);* **20**: No. 4, 697-704(Jul 1977).

A rainfall simulation was used to measure run-off and erosion from rangeland, spoil and topsoil sites. Measured soil losses were greatest on bare topsoil plots and least on the non-cultivated rangeland site. Application of a straw mulch reduced erosion on topsoil by over 90 percent. However, the measured erosion and run-off values from the mulched topsoil sites were still over 50 percent higher than from the rangeland site.

54358 Underground mining with controlled subsidence to Lower Duisburg harbour. Legget, R.F. *Underground Space;* **1**: No. 1, 51-58(May 1976).

Duisburg on the Rhine, at the heart of the Ruhr, one of Europe's greatest industrial areas, is the world's largest inland port. Located at the junction of the Rhine and Ruhr Rivers, its harbour includes twenty major docks with a total of 45 km of wharves over which more than 45 million tons of cargo are handled each year. Starting in the middle of the nineteenth century, the course of the Rhine has been improved by straightening, cleaning and dredging. A serious drop in upstream water levels has been the inevitable result, 2 m at Duisburg since 1900, with the prospect of a similar drop by the end of this century. Geological strata beneath the harbour area include three valuable coal seams, mining of which had been prohibited for centuries. After careful study it was decided to extract most of this coal by controlled mining in this way causing subsidence of the whole harbour area to counterbalance the drop in river level. Mining was started in 1956; by 1968, when work had to stop, most of the harbour had been lowered as much as 1.5 m, with no interference with its normal operation.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 54230, 55240

54359 Good mining-equipment prospects in Australia. *Mine Quarry;* **7**: No. 5, 28, 30, 33, 36, 38(May 1978).

The importance of the mining industry to Australia's external situation has been further enhanced in recent years notwithstanding the economic recession. The unprecedented upsurge of the industry during the boom years of the late 1960s took mineral exports to a level at which they have virtually sustained the Australian standard of living in the face of a world recession. The downturn in demand for wool and beef would otherwise have had serious consequences for a country so heavily dependent on export revenues from primary products. Minerals exports now account for some A$3500 million of Australia's total export trade of over A$9000 million pa. A star performer among the contributors to this substantial mineral total is coal; the value of Australian exports of coal is now running at about A$1000 million per annum. The importance of Australia's immense coal resources has been very considerably enhanced by the rise in world oil prices, and it will be added to still further if research succeeds in finding an economic process for coal liquefaction.

54360 Barrier and back-barrier environments of deposition of the Upper Cretaceous Almond Formation, Rock Springs Uplift, Wyoming. Flores, R.M. (Geological Survey, Denver). *Mt. Geol.;* **15**: No. 2, 57-65(Apr 1978).

Detailed analysis of the detrital rocks associated with coal deposits in the upper part of the Upper Cretaceous Almond Formation of the Mesaverde Group has resulted in the identification of coal depositional settings. The several lithofacies indicate that depositional environments of this interval in the upper part of the Almond Formation include shoreface, barrier island, tidal inlet, tidal delta, washover fan, tidal flat, lagoon, tidal creek, overbank, pond, and marsh. Tidal delta, tidal-inlet-channel, washover-fan, and tidal-creek deposits significantly affected back-barrier accretion and lagoon filling. The complete filling of the lagoon led to coalescing of marsh on the back side of the barrier island with the marsh on the landward side of the lagoon. Thin, discontinuous coal beds which rapidly grade into carbonaceous shale formed in the marsh in close proximity to the barrier island. Thin to thick, laterally extensive coal beds that locally grade into carbonaceous shale formed in the marsh on emergent levee, overbank, and bayfill deposits at the landward side of the lagoon. Deposition of the above detrital deposits as well as tidal-creek channel sandstones caused splitting and merging of the coal beds. The depositional process and rate of sedimentation and subsidence in the depositional basin influenced to some degree the lateral variation of the coal beds. Minability and resource potential of coal beds in the Almond Formation can be better assessed if the precise distribution of the sedimentary environments is recognized.

54361 One of nature's valuable deposits. Hopkins, K.R. *Min. Technol.;* **60**: No. 688, 69-73(Feb 1978).

This paper describes the formation of coal deposits, briefly reviews the history of coal use in the UK, and lists coal products and indicates some of their uses.

54362 Possibilities of genetical interpretation of joints in coal series with Stereoscan. Gagel, L.; Murawski, H. *Neues Jahrb. Geol. Palaeontol., Monatsh.;* No. 12, 705-719(Dec 1977). (In German).

A tectonic research program in the coal-mining region of Lower Rhine (FRG) included the control of joint surfaces in some coalbeds with Stereoscan. The Stereoscan pictures may help to clear the genesis of the joints, whether caused by tensile, congressive, or shearing stress. The right-angled joints were formed from the combination of pressure of overlying sediments and diminution of volume during coalification. In contrast to the joint systems which are right-angled and normal to the bedding, the joints with angles less than 90° to the bedding show a good lineation on the surfaces. Such a structure proves shearing.

54363 Seismic reflection exploration of multiple seams of stratified coal-bearing formations. Ruetter, H.; Schepers, R. *Glueckauf-Forschungsh.;* **38**: No. 6, 217-222(Dec 1977). (In German).

A method is described of calculating theoretical seismograms for single seams, pairs of seams, and sequences of seams. The object of these calculations is to achieve a better understanding of reflections in the Carboniferous, so that field measurements can be reliably interpreted, and so that seismic reflection can be evaluated as a method of exploration.

54364 Open-file records of departmental coal exploration. *Queensl. Gov. Min. J.;* **78**: No. 913, 552-555(Nov 1977).

The geographic locations are shown of drilling programs which have been reported in detail by the Coal Section of the Geological Survey of Queensland in the unpublished Record Series. A list is given of the Records available on open file at the Geological Survey Office in Brisbane.

54365 Hat Creek coal utilization. Papio, M.M.; Warren, I.H.; Woodley, R.M. *CIM Bull.;* **70**: No. 787, 99-105(Nov 1977).

The location and extent of the Hat Creek coal deposits are outlined. The mineable amounts of coal are estimated and the potential economic significance of the deposits indicated. The properties of the coal are described and its suitability for various alternative uses discussed. The possible uses of the coal for direct combustion in electricity generation and in other uses such as gasification are reviewed. The economics and markets for the products of possible processes which have been examined are outlined.

54366 Reflections on Canada's fossil fuels. Hunt, A.D. *CIM Bull.;* **70**: No. 786, 68-73(Oct 1977).

Measured Canadian coal resources are 30 billion tons, indicated are 20 billion, and inferred are 200 billion, 2 billion tons of this total being in Eastern Canada. There are one and a half billion tons of metallurgical coal and 4 billion tons of thermal coal.

54367 Geotectonic disturbances in the Lippe synchine north of Moers. Arauner, H.W. *Glueckauf-Forschungsh.;* **38**: No. 4, 162-167(Aug 1977). (In German).

This paper describes the geological situation of the Rheinland colliery. The disturbances and clefts formed in the Heideck fault trough and in the Rheinkamp block by tectonic forces are discussed.

54368 Tectonic basal areas as a basis for evaluating coal deposits and for mine planning in the Ruhr carboniferous. Lautsch, H. *Glueckauf;* **113**: No. 14, 712-717(21 Jul 1977). (In German).

This paper explains what a tectonic basal area is, and compares the representation of a region in terms of tectonic basal areas with the conventional representation. An example from practice is described, in which predictions of the position of saddles and troughs made after study of the tectonic basal areas involved were confirmed by boreholes and seismic measurements. The positions of disturbances were predicted from tectonic trends.

54369 Well logging tests at Huntly coalfield, 1976. Syms, M.C. Wellington, New Zealand; Dept. of Science and Industrial Research (1977). 15p.

Initial testing of resistivity, self-potential, and temperature logging has been carried out in bores drilled in the Huntly Coalfield. Coal seams showed a marked resistivity contrast compared to the

surrounding mudstone. Comparison of resistivity logs with the ash content of core samples indicates that a reasonable idea of coal quality can be gained from the logs.

54370 Systematic interpretation and control of coal reserves utilization by the workability qualifying method. Oplaznik, G. *Publ. Hung. Min. Res. Inst.;* No. 19, 225-237(1976). (In Russian).

The utilization of coal reserves is considered on the basis of systems analysis. Shows how the workability classifying method, introduced in 1970 and still being revised, serves to evaluate the available reserves.

MINING

REFER ALSO TO CITATION(S) 54353, 54356, 54357, 54358, 54515, 54516, 54517, 54520, 54523, 55860

54371 MRDE projects 1976/1977. Burton-on-Trent, Eng.; Mining Research and Development Establishment (1977). 53p.

Mining Research and Development Establishment presents details of MRDE's work on underground mining at the coalface; roadway drivage; underground transport; coal preparation; comprehensive monitoring; mine environment; and testing.

54372 Use of radio in the coalmining industries of the European Community. Lefevre, A. (Centre d'Etudes et Recherches des Charbonnages de France (CERCHAR), 75 - Paris. Lab. d'Electronique); Liegeois, R. (Institut National des Industries Extractives (INIEX), Liege (Belgium). Forschungsabteilung); Martin, D.J.R. (National Coal Board, Burton-on-Trent (UK). Mining Research and Development Establishment); Olaf, J. (Bergbau-Forschung G.m.b.H., Essen (Germany, F.R.). Abt. Fernwirktechnik). *Glueckauf;* **114**: No. 12, 510-513(Jun 1978). (In German).

The article reports on the use of communication systems and remote control in connection with winning, drivage, and transport, as voice communication within faces, as a wireless communication system in roadways and shafts and as a public address system underground. Costs, advantages, limits and fields of application are discussed. The information refers to the four coal mining countries of Western Europe: Federal Republic of Germany, Great Britain, France and Belgium.

54373 Strata bolting in conjunction with sprayed concrete in stonedrifts of coalmines. Nocke, H. *Glueckauf;* **114**: No. 4, 163-168(Feb 1978). (In German).

A new process for mining for the fastening of strata at great depth in Ruhr coalmines is described. First results with the strata bolting in the form of a supporting ring with an inner shell of sprayed concrete, show that its quality of fastening is higher, for the same cost, than conventional steel ring fastening. A constructional steel framework is anchored on the strata of drift superstructure consolidated by the dry spraying process which is included about 20 meters behind the location in an inner shell of sprayed concrete about 10 to 15 cm thick. Thus, while protecting the strata there is a quick, effective support having high supporting force, which should maintain the mining capability of the strata.

54374 Changing pattern of technology in Indian coal mining industry. Mitra, D.K. *Indian Min. Eng. J.;* **17**: No. 2, 11-12(Feb 1978).

Planning in India's nationalized coal industry is discussed. Coal production is to increase by 8 to 9% per annum for the next decade. Indian industries, particularly mining, are in need of low-cost, intermediate technology and not a capital intensive, sophisticated technology where the labor content of the technological input is reduced to the minimum. Thus, the Indian industry will use methods obsolete in the developed countries. Plans for improvement in mining methods, working conditions, safety, higher wages, etc. are discussed briefly. (LTN)

54375 Some electrical aspects of environmental monitoring and remote control at Manton Colliery. Thompson, G.; Armitage, B. *Min. Technol.;* **60**: No. 688, 53-67(Feb 1978).

This paper describes continuous mine air analysis, firedamp drainage monitoring, the monitoring and control of fans and pumps, and other remote control systems used at Manton Colliery.

54376 Sinking dry shafts in competent waterbearing strata to great depths. Hanke, N. *Min. Mag.;* **138**: No. 2, 159-160(Feb 1978).

This paper reviews the two methods for eliminating water inflow in shafts, the injection method for sealing the strata and the provision of a watertight lining by freezing, draining and pumping.

54377 Rubber-tired versus rail haulage as a service function. Dwosh, D.M. *Min. Congr. J.;* **64**: No. 1, 39-43, 57(Jan 1978).

An analysis was conducted to compare rubber-tired haulage and track haulage for a proposed shaft mine using room and pillar extraction. Rubber-tired vehicles are more economical for haulage distances up to at least 30,000 ft. The advantages of each system are listed.

54378 German experience in hydraulic coal mining and its application to Canadian conditions. Harzer, H.; Geller, L.B. *CIM Bull.;* **71**: No. 789, 70-82(Jan 1978).

Most Western Canadian coal is in severely distorted structures where hydraulic mining may be the best extraction method. Details are given of plans for mining Western Canadian coal, and German work on, and experience with, hydraulic mining is described. German mining conditions are compared with those in Canada. There is an extensive bibliography.

54379 Methane drainage in Germany and in the member countries of the European Community. von Treskow, A.; Fitzner, G. *Glueckauf;* **113**: No. 23, 1129-1130(1 Dec 1977). (In German).

Statistics are given of methane drainage in each German coalfield, and in Britain, France and Belgium.

54380 Basic data on the layout of rise headings in mining by rise control caved longwall faces. Piaskowieck, A.A. *Przegl. Gorn.;* **33**: No. 12, 580-586(Dec 1977). (In Polish).

Some new layouts of rise headings are presented and analyzed.

54381 Corrosion resistance of zinc coating in an aggressive mine environment. Sobolewska, M. *Przegl. Gorn.;* **33**: No. 12, 559-562(Dec 1977). (In Polish).

The protective properties of zinc coatings in a mine environment are discussed. In shafts where natural mineral-containing waters occur, the durability of zinc coatings has proved satisfactory. Methods of additional protection of zinc coating by chromate coating and by paint are described.

54382 Equations describing contamination of run of mine coal with dirt in the Upper Silesian Coalfield. Winiewski, J.J. *Przegl. Gorn.;* **33**: No. 12, 575-579(Dec 1977). (In Polish).

Statistical analysis proved that contamination with dirt of run of mine coal from seams in the series 200 to 600 of the Upper Silesian Coalfield depends on the average ash content of a given raw coal. A regression equation is deduced for coarse and fine sizes of each coal. These equations can be used to predict the degree of contamination of run of mine coal to an accuracy sufficient for coal preparation purposes.

54383 Stability and determination of the thickness of a protective coal bench under a weak immediate roof. Kidybinski, A.; Michalski, A. *Przegl. Gorn.;* **33**: No. 12, 551-558(Dec 1977). (In Polish).

Studies on models were used as a basis for calculation, by the method of limite elements, of stresses in weak roof rocks over a longwall face with protective coal benches 0, 0.20, 0.40, 0.60 or 0.80 m thick. The stability index is given for three typical coal strengths. Guidelines are given for choosing the thickness of the coal bench left.

54384 Elastic roof bolts with rubber heads. Pochcial, Z. *Przegl. Gorn.;* **33**: No. 12, 546-551(Dec 1977). (In Polish).

Selection criteria for this type of roof bolt were determined on the basis of tests. The design of the bolts is discussed, and an optimum geometry of the rubber sleeve is determined. Rapidly increasing rock deformations have no effect on the work characteristics of bolts with rubber heads.

54385 Turning a mechanized longwall face through 180°. Skimina, Z. *Przegl. Gorn.;* **33**: No. 12, 542-545(Dec 1977). (In Polish).

The turning of a mechanized longwall face through 180 deg is described, the conditions under which this method can be used are discussed, and the technical and economic advantages which accrue are indicated.

54386 Sensitive vibrating wire rock bolt load gage. Babcock, C.O. *Trans. Soc. Min. Eng. AIME;* **262**: No. 4, 293-299(Dec 1977).

A simple robust rock bolt load gauge was tested in the laboratory to define its characteristic behavior and to obtain a measure of its performance. The gauge uses three vibrating wire sensors crimped 120° apart into the outer surface of a hollow cylindrical steel tube. The resonant frequencies of the wires change as the gauge is loaded. This change is read with a Creare meter to read borehole stress gauge results. A statistical analysis of data obtained defines the variables influencing results.

54387 Control of the cutting horizon of shearer loaders. Henkel, E.H.; Heck, L. *Glueckauf-Forschungsh.;* **38**: No. 6, 207-211(Dec 1977). (In German).

This paper discusses possible methods of sensing the position of the boundary between a coal seam and the rock. Tests of a device which uses two sensitized picks to detect the seam boundary in a simulated coal seam show that this method could be used even

where the hardness of the rock is only 2.4 times that of the coal. Details are given of the further development work which is planned.

54388 Determination and evaluation of the explosibility of mine fire gases. Mueller, R. *Glueckauf-Forschungsh.;* **38**: No. 6, 223-230(Dec 1977). (In German).

The requirements which would be met by an ideal method of determining the explosibility of the gases evolved from mine fires are listed. Describes a method which is not dependent on the number of combustible gases present. It is possible to take into account the effect of changes in the gases between the seat of the fire and the sampling point, to predict changes in explosibility, and to calculate the amount of additional nitrogen required to bring the gas mixture outside the explosive limits. Programming of a pocket calculator for use with the method is outlined.

54389 Face technology in German coal mining in 1976. Kundel, H. *Glueckauf;* **113**: No. 22, 1078-1086(17 Nov 1977). (In German).

This paper gives statistics on the methods of winning, equipment used, and on production during 1976, and briefly discusses research and development which was carried out.

54390 Behavior of wire-mesh lagging in service underground. Buergel, H.; Stegemann, H.C. *Glueckauf;* **113**: No. 22, 1086-1091(17 Nov 1977). (In German).

Tests at the Tremonia experimental mine and experience in collieries showed that corrosion protection is necessary for wire-mesh lagging in roadways with a working life of more than two years. Comparative tests of mats with different types of corrosion protection are reported, and the requirements which coatings must meet are discussed.

54391 Improvement of methane drainage by sealed borehole casings. Koppe, U.; Stegmanns, W. *Glueckauf;* **113**: No. 22, 1091-1094(17 Nov 1977). (In German).

If the space between the rock and the casing of a methane drainage borehole is sealed, the methane concentration and the flow of methane increase by up to 50%. The space can be filled with polyurethane foam. The results of tests in the laboratory and underground are reported.

54392 Behaviour of lagging mats during their working life underground. Buergel, H.; Stegemann, H.C. *Glueckauf;* **113**: No. 22, 1086-1091(Nov 1977). (In German).

This is a report on long-term corrosion tests in the Tremonia test mine and other mines. It was found that corrosion-proof lagging mats are necessary in roadways which are worked longer than two years. The findings of comparative investigations with lagging mats with different types of corrosion protection are given. Suppliers ought to inform on the quality of the coating materials. Test methods for users of corrosion-proof lagging mats are recommended.

54393 Crossing geological disturbances with mechanized longwall faces. Kozionov, E.M. *Przegl. Gorn.;* **33**: No. 11, 529-532(Nov 1977). (In Polish).

The influence of geological distrubances on production from a working face is discussed. Parameters determining the state of rock masses obtained from measurements in mines in the Kusnetz Basin and calculated parameters, are given. Measures for reducing the influence of geological distrubances on safety at the face are presented.

54394 Protection of openings without leaving coal pillars. Shtumpf, G.G.; Zaidenvarg, Z. *Przegl. Gorn.;* **33**: No. 11, 526-528(Nov 1977). (In Polish).

Methods used in the Kusnetz Basin for protecting mine openings without leaving coal pillars are discussed. The method used at three mines was found to be more effective than are coal pillars.

54395 Development of methods of rock burst control in Soviet mines. Petuchov, J.M. *Przegl. Gorn.;* **33**: No. 11, 514-521(Nov 1977). (In Polish).

The results of tests on rock bursts in underground mines in the USSR carried out during the last 25 years are reported. The causes and the energy balance of rock bursts have been determined, and effective methods of combating rock bursts have been tested. Where rock bursts are likely, teams are active in forecasting them and in assessing the efficiency of preventive measures.

54396 Grouting old mine workings at Merthyr Tydfil. *Ground Eng.;* **10**: No. 8, 24-27(Nov 1977).

Old underground coal workings on the site of a new factory were consolidated by drilling and grouting. Five shafts were also filled.

54397 Roadway machines. Bunniss, A.F. *Min. Technol.;* **59**: No. 685, 492-500(Nov 1977).

This paper describes mobile equipment used in connection with roadway drivages, both in coal and/or stone. It gives details of the types of machine available, their design and functional requirements. Emphasis is placed upon design (and development) considered necessary for the progression from the phototype roadway cutter loader to the more powerful roadheader machines. As a result of research, development and experience, derivatives or "spin off" types of machines based on the basic roadheader design were produced. Several are briefly described and their functions explained. Other important aspects, such as benefits obtained through paying attention to correct installation, commissioning and maintaining of equipment are described.

54398 Where else for advanced technology mining. *Mine Quarry;* **6**: No. 11, 39-44(Nov 1977).

This paper outlines activities and plans related to Advanced Technology Mining, and reports on the outputs per manshift which have been obtained on ATM faces. The Gullick Dobson roof support control system is described.

54399 Development of tracked undercarriages and materials transporters. Sawyer, H.R.; King, N.S. *Min. Technol.;* **59**: No. 685, 503-508(Nov 1977).

This paper deals with the development of materials transporters. Mobile drill bases and powered undercarriages and discusses their applications and potential.

54400 Anderson Strathclyde mobile machinery. Wakefield, A.K. *Min. Technol.;* **59**: No. 685, 515-519(Nov 1977).

The "Dreadnought" universal arc shearer, the AM 400 arc-wall coalcutter, and the MC3A, MC4A and AM71 gathering arm loaders are described.

54401 Review of face end mechanisation in the NCB. Carr, T.L. *Glueckauf;* **113**: No. 19, 940-945(6 Oct 1977).

This article reviews the progress made in machine and system design and describes some of the face end systems now in operation. It presents background information on the reasons underlying the need for this R and D and describes and illustrates the development of the face end equipment to date. It is shown that machines available are capable of being integrated into face end systems, but further development and trials are required and this work is forming an ECSC sponsored project.

54402 Fully mechnized winning with solid stowing in thick seams at Nordstern Colliery. Voss, K.H.; Sielaff, H.D. *Glueckauf;* **113**: No. 19, 933-937(6 Oct 1977).

Work at Nordstern Colliery on the development of technology for mining seams 2 to 4 m thick in conjunction with pneumatic stowing. The equipment used, including the stowing system, is described, and operational results are tabulated. Daily output per face reached 2350 tonnes, with a face output per manshift of 28 tonnes.

54403 Successful coal winning with two shearers using chainless haulage. Fritz, W. *Glueckauf;* **113**: No. 19, 937-940(6 Oct 1977).

Coal winning in one production district at Rheinpreussen Colliery is described. Extracted seam thickness is 2.95 m, of which 1.15 m is dirt. Eickhoff double-ended ranging shearer loaders with Eicotrack chainless haulage have proved successful, even though this coal is difficult to cut because of the dirt bands. The introduction of twin-belt conveyor drives allowed the distances between centers in the long-haul belt systems to be increased, thereby improving safety.

54404 Non-blunting tool for cutting coal and rock. Kenny, P.; Johnson, S.N. *Colliery Guardian;* **225**: No. 10, 760-763(Oct 1977).

The results of laboratory and underground tests of a non-blunting tool for cutting coal and rock are reported. The tip of the tool has a thin, hard layer on its make face, with a thicker, softer layer behind it. Current work at MRDE is aimed at the production of robust versions of the tool suitable for underground use. Among the advantages expected is the fact that reduced energy dissipation at the tool tip should limit the energy available for frictional ignitions and, possibly, dust production.

54405 Method of assessment of tightness of stoppings. Przeczek, B. *Przegl. Gorn.;* **33**: No. 10, 443-444(Oct 1977). (In Polish).

A formula is proposed for calculating an index of the decrease in oxygen concentration at a point near a stopping. Limiting values for this index under the conditions in Rymer Colliery were calculated. The need for this index when estimating hazards due to gas outflow from gobs into mine workings is explained.

54406 Analysis of auxiliary ventilation with regard to mine air conditions. Markefka, P.; Stefanowicz, T. *Przegl. Gorn.;* **33**: No. 10, 445-453(Oct 1977). (In Polish).

A method of analyzing auxiliary ventilation systems is presented. It is shown, using as an example three blind roads in a Polish mine, that this kind of analysis is necessary.

54407 Investigation by the tracer method of the water balance when filling the gob with slurries. Jureczko, J.; Skowronek, E. *Przegl. Gorn.;* **33**: No. 10, 483-487(Oct 1977). (In Polish).

The conditions of water flow when filling old workings with slurry were investigated in order to determine the degree of water hazard in mine workings. A chromium—EDTA complex was used as tracer. Geological and mining conditions in the area investigated, and distribution of stowing slurry, are described.

54408 Longwall mining, with particular reference to its implementation in South African collieries. Jurd, R.G. *J. S. Afr. Inst. Min. Metall.;* **78**: No. 3, 63-72(Oct 1977).

This paper considers the introduction of large-scale longwall mining into South African coal mining, instead of the conventional mechanized bord-and-pillar mining that is widely practiced at present. The two methods are compared, and longwall mining is found to have the advantage in several respects in some seams. The most cogent reasons for the introduction of the longwall method in some seams are associated with safety, strata control, and labor costs.

54409 Mechanical packing in Great Britain. Einhauser, J. *Glueckauf;* **113**: No. 18, 904-905(15 Sep 1977). (In German).

Paper describes the Thyssen pump packing system used at Brynlliw Colliery and the pneumatic stowing method at Prince of Wales Colliery.

54410 Roof falls in machine headings. Zischinsky, U. *Glueckauf;* **113**: No. 17, 847-853(1 Sep 1977). (In German).

This article describes the effects of roof falls in machine headings and discusses possible prediction techniques based on geological data or on experience in similar strata.

54411 Opening of a sealed area at Northfield Colliery. Watson, J.R. *J. Mine Vent. Soc. S. Afr.;* **30**: No. 9, 177-186(Sep 1977).

An area of Northfield Colliery, Natal, was sealed in 1951 following a fire and associated explosion. This meant the loss of some 2 million tons of good quality coking coal. An account is given of steps taken to reopen the area, first in 1963 when an initial examination was made, and finally in 1964 when the whole section was reopened.

54412 International mining exhibition. Burton, A.B. *Colliery Guardian;* **225**: No. 9, 654-657(Sep 1977).

This paper discusses some of the types of mining equipment shown at the exhibition held in Birmingham. The equipment relates to drivage through coal or associated strata; longwall face support; longwall coal winning; transport; and monitoring and remote control.

54413 Analytical method for predicting and fighting rock bursts in mines. Gil, H. *Przegl. Gorn.;* **33**: No. 9, 381-386(Sep 1977). (In Polish).

The theoretical basis of an analytical method for predicting and controlling rock bursts is outlined, and the use of the method for determining, at the mine planning stage, the zones liable to rock bursts is demonstrated.

54414 Control of thermal conditions at great depths. Khokhotva, N.N.; Yakovenko, A.K. *Ugol;* **52**: No. 9, 59-65(Sep 1977). (In Russian).

In view of the increased depth of workings in the Donbass consideration must be given to refrigeration or air conditioning. The different types of equipment available are described and their performances are compared.

54415 Pneumatic powered hoists used in the mining industry. Wallace-Dunlop, K. *Hydraul. Pneum. Mech. Power;* **23**: No. 273, 337-340(Sep 1977).

The design and development of compressed air powered hoists for the coal mining industry are discussed together with their advantages over electrical hoists.

54416 Formation of fractures in the main roof in the vicinity of a working face, in the light of investigations carried out by the geophysical electrical resistance method. Goszsz, A. *Przegl. Gorn.;* **33**: No. 9, 397-402(Sep 1977). (In Polish).

This paper describes underground investigations carried out to determine the places where fractures would occur in the main roof under working conditions. The mechanism of fracturing is described, and the range of fracturing is determined approximately.

54417 Phenomena associated with great depth of coal seams in the northeastern part of the Rybnik Coalfield. Borowski, J.; Sasnowski, M. *Przegl. Gorn.;* **33**: No. 9, 402-407(Sep 1977). (In Polish).

Coal has been found at great depths in the Rybnik Coalfield. Coalification increases with depth, and consequently the occurrence of anthracite is expected. Because of the temperature increase, the sorptive capacity of coal in the anticlinal strata is about 50% less than that in shallow seams in Zaleze strata; this means there is less gas in the deeper seams.

54418 Automation of coal shearer loaders. Kruzecki, L. *Przegl. Gorn.;* **33**: No. 9, 414-417(Sep 1977). (In Polish).

A new type of drive for a shearer loader which is described is more suitable for automatic control than are existing drives.

54419 Reaction between infusion water and methane. Ettinger, I.L. *Khim. Tverd. Topl.;* No. 5, 9-16(Sep 1977). (In Russian).

This paper discusses the effect of infused water on the initial gas emission rate and on the pore structure of the coal. Water traps methane in micro-pores, so that lengthy periods are needed for the methane to penetrate large voids and cavities.

54420 Cutting with round and flat picks. Eichbaum, F.; Bendlmayr, H. *Glueckauf;* **113**: No. 16, 798-800(18 Aug 1977). (In German).

Comparative tests showed that tangential, round picks are superior to radial flat picks in terms of output for a given power input for the easily-worked coal and soft neighboring strata in which they were tested.

54421 Concept of pinning and stringing of hangwall. Bose, S.K. *J. Mines, Met. Fuels;* **25**: No. 8, 223-227, 235(Aug 1977).

In seams under shallow cover, extracted by room and pillar mining, for extraction thicknesses of 4-8 m the hangwall can be supported by rock bolting and roof stringing.

54422 Use of synchros for accurate depth indication of mine hoists. Mittra, D.K. *J. Mines, Met. Fuels;* **25**: No. 8, 232-235(Aug 1977).

A synchro can be used to measure the motion of the winder drum, and thus to indicate the depth of the cage.

54423 Early detection of the danger of gas outbursts on the basis of a determining of the k-value. Janas, H.; Winter, K. *Glueckauf-Forschungsh.;* **38**: No. 4, 131-138(Aug 1977). (In German).

A method of determining the k-value and the desirable methane content of coal underground is described. The results of investigations of outbursts at various mines are discussed. The scatter of k-values of samples from a normal seam is relatively small; a greater scatter indicates that an outburst-prone zone may be nearby. An automatic desorption meter with electronic calculation of the results is being developed. Outburst-prone zones cannot always be predicted with certainty by this method.

54424 Report from Australia. Major expansion in coal mining coming. *North. Miner;* **63**: No. 13, 1, 22(21 Jul 1977).

A number of huge new coal mining projects getting or about to get off the ground are described briefly. The development of these new coal projects ensures a capital spending boom over the next three to four years.

54425 Ultrasonics applied to coal extraction. Lesniak, K. *Koks, Smola, Gaz;* **22**: No. 78, 198-200(Jul 1977). (In Polish).

The results of investigations of the extraction of a Polish coal which had previously been submitted to the action of ultrasounds are reported.

54426 Britain aims at completely automated coal mining. *Coal, Gold Base Miner. South. Afr.;* **25**: No. 6, 85-89, 93(Jun 1977).

This paper examines the increasing sophistication of British coal mining machinery and previews a conference on remote control and monitoring that is to be held in conjunction with the International Mining Exhibition in Birmingham in October.

54427 Selection of the dimensions of mine workings. Kuznetsov, K.K. *Ugol;* **52**: No. 6, 14-19(Jun 1977). (In Russian).

The factors affecting the choice of dimensions, in order to maximize production potential in the most economic manner, are discussed.

54428 Kleinkopje awards management contract. *Coal, Gold Base Miner. South. Afr.;* **25**: No. 6, 31(Jun 1977).

Amcoal has awarded Weserhuette South Africa (Pty) Ltd a major equipment contract in connection with the R109 million Kleinkopje opencast project near Witbank that is scheduled to commence operations in January 1979 and to produce 2.7 million sales ton per annum increasing to 4.3 million sales ton a year by 1982.

54429 Vierfontein sinks new shaft to replace lost production. *Coal, Gold Base Miner. South. Afr.;* **25**: No. 6, 19, 21(Jun 1977).

Poor mining conditions in two areas of Anglo American's Vierfrontein Colliery have necessitated the sinking of a new shaft on the farm Marseilles 524 in an isolated area of coal. Bord and pillar mining methods will be used for the new endless rope haulage shaft, known as the Mars shaft, that is expected to be in production by September 1977. Reserves of Vierfontein seam coal have been esti-

mated at 3,000,000 t. Vierfontein is in the district of Viljoenskroon in the Northern Orange Free State.

54430 Drilling shafts 600 to 1000 mm in diameter using a Hausherr drill at Mines de Potasse d'Alsace. Streckdenfinger, M.; Diemunsch, J. *Ind. Miner., Mine;* No. 3, 129-137(Jun 1977). (In French).

At Mines de Potasse d'Alsace the classical methods of working are carried out by retreat mining, using two parallel roads driven into the deposit. In the lower "Theodore" deposit, the poor behavior of these roads gave rise to another cutting out method: a road is driven into a layer of rock salt, 20 meters above a single road cut into the layer. In order to remove material, these two roads are joined up by shafts spaced 50 meters apart. The development of a fast and cheap shaft drilling method is described. The drilling machine chosen was a HAUSHERR HBM 25 K/HY. which can drill, from the bottom upwards, shafts 600 to 1000 mms in diameter, at a single pass. A description of the drill, and in characteristics; modifications to drill and performance obtained; and running cost and profitability (year 1974) is given. Shafts drilled by contractors cost 30,000 francs, whereas shafts drilled by the Hausherr machine cost 6,000 francs.

54431 Mechanisation of coal mining in thin steep seams using the Dressmatic II. *Ind. Miner., Mine;* No. 3, 161-172(Jun 1977). (In French).

This paper gives details of the Cecile seam at Merlebach which has been used to test the Dressmatic Machine. This machine comprises a frame sliding on struts along side the steel timbering, supporting shoes on the floor and a turret cutting head 1.6 meters wide. The drum is fitted with picks having a linear speed of 2.7 meters/sec. The coal, which is rather soft, is cut in 5 meter slices. The machine breaks out an end and then moves to the opposite end, during backfilling. The time taken for the work cycle on the face is 65 minutes including lost time. Work to be done when an end is broken down is described. Results obtained: 11.16 tonnes per manshift were won. Development of this type of mechanization and problems to be solved especially as regards hard seams are discussed.

54432 Construction of anhydrite dams. Bortoluzzi, L.; Francois, G. *Sekiyu Gakkaishi;* 12-14(May 1977). (In French).

To construct a ventilation dam, the road is closed with a fibreglass sheet onto which 3 or 4 cm of anhydrite paste is sprayed. The equipment necessary is described, and the cost is compared with that of an aggregate dam.

54433 Utilisation of acoustic signals from shearer picks to indicate inclusions in seams. Krivosheev, Yu.T.; Koval, T.P. *Ugol Ukr.;* **21**: No. 5, 32-33(May 1977). (In Russian).

This paper briefly describes an instrument for recording acoustic signals on tape and their subsequent analysis to obtain a "map" of seam inclusions.

54434 Coal industry of our country. Ch'un, T. *Ti-li Chih-shih;* No. 5, 1-4(May 1977). (In Chinese).

China's coal industry prior to 1948 consisted of some 72 coal producing areas with a total output of 30 million tons. After liberation, a balanced production-consumption policy was promoted by which the coal industry made big strides. During the first five-year plan the old, rich coal producing areas were expanded and modernized. Strip mining was also undertaken on a large scale. Several new areas in Honan, Inner Mongolia, and Szechwan were developed. After the implementation of the second five year plan new production areas in Kwangsi, Kwangtung, Hunan, and Kiangsi were established. Total coal production thus reached third position in the world. Today the nine provinces south of the Yangtze River are 70 percent self-sufficient. A general northern concentration was changed to a broad distribution throughout the country.

54435 How the degree of coalification affects spontaneous combustion tendencies in Donbass coals. Saranchuk, V.I. *Khim. Tverd. Topl.;* No. 3, 78-81(May 1977). (In Russian).

Analysis of spontaneous fire statistics for Donbass colleries illustrates the variation in the susceptibility of coals as a function of rank. Coals with 76, 85 and 89% carbon show an increased tendency to spontaneous combustion. Coals with 80 to 82.9% carbon can be worked without taking special measures against spontaneous combustion.

54436 75 years electrical engineering in the German brown coal mining industry. Kassler, K.H. *Braunkohle;* **29**: No. 4, 137-142(Apr 1977). (In German).

The Rhenish brown coal fields, which had to change over from surface to deep opencast mining after the second world war, and where completely new mining techniques with the appropriate equipment and prime movers had to be developed, was a special challenge for electrical engineering in German brown coal mining. If the efforts made to provide economic technology were successful, this was because there was a great deal of experience to fall back on. This article shows the historical development in the last 75 years, adapted to the given framework, in respect of one sector of this special field of electrical engineering.

54437 Gas composition as an indicator of outburst propensity of coal seams. Khorunzhii, Yu.T. *Ugol Ukr.;* **21**: No. 4, 42-44(Apr 1977). (In Russian).

It has been shown that variations in the helium and hydrogen content of gases in outburst-prone seams can indicate changes in the state of stress and deformation of the coal mass. An increase in the helium content, together with an increase in the rate of gas emission and a drop in gas pressure is a sign that disturbance of the strata is occurring. It is hoped that this information can be used to help to combat outbursts of coal and gas and to assess the effectiveness of preventive measures. The results of measurements in several collieries are given.

54438 Sigma may establish second longwall face. *Coal, Gold Base Miner. South. Afr.;* **25**: No. 3, 19-23(Mar 1977).

The operation of the longwall face at Sigma Colliery, its equipment and output details are discussed. A second face with a larger shearer is planned. This colliery provides coal for the Sasol oil-from-coal plant and power stations.

54439 Wear of shearer picks: a present day problem of outstanding importance. Florea, C. *Mine, Pet. Gaze;* **28**: No. 2, 65-70(Feb 1977). (In Rumanian).

The causes and effects of pick wear are pointed out, and research into the reduction of wear is described. (In Romanian)

54440 Investigation of the picks of a longwall shearer. Marian, I. *Mine, Pet. Gaze;* **28**: No. 2, 56-64(Feb 1977). (In Rumanian).

The results of research into the shape and other parameters of shearer picks are reported. Experimental data obtained in the Motru coal basin are reported. (In Romanian)

54441 MRDE 1976/1977: Mining Research and Development Establishment annual report. Burton-on-Trent, Eng.; Mining Research and Development Establishment (1977). 24p.

The annual report discusses the policy and programme of MRDE and outlines its works on the coalface; roadway drivage; underground transport; coal preparation; comprehensive monitoring; basic studies; and testing. Discusses the role of the new training centre in technological transfer. Lists aspects of overseas collaboration.

54442 British coal mining industry, 1870—1946: political and economic history. Kirby, M.W. London; Macmillan (1977). 284p.

This book analyses the motives and rationale of government policy towards the British coal mining industry between 1870 and nationalisation in 1946. Discusses the economic history of the industry during this period and gives particular attention to the interplay of political and economic forces in policy formulation.

54443 Remote control of colliery operations by computer. Bexon, I. London; National Coal Board (1977). vp.

From International conference on remote control and monitoring in mining; Birmingham, England (11 Oct 1977).

The National Coal Borad's Mining Research and Development Establishment has been engaged since 1972 in the experimental application of small dedicated computers to mine monitoring and control. A standard, modular system has resulted in which all applications are based on a single design philosophy and common elements of hardware and software. The system is called MINOS and commercial versions of it are available from a range of suppliers. Describes the MINOS concept and illustrates its application to colliery operations with examples from operating coal clearance, environment and production monitoring systems.

54444 Proceedings of the Third International Symposium on Jet Cutting Technology. Cranfield, England; BHRA Fluid Engineering (1977). 556p.

From 3. international symposium on jet cutting technology; Chicago, IL, USA (11 May 1976).

The symposium included papers on the fluid mechanics of jets; experimental studies of pulsed jets; jet cutting equipment; mining applications; rock cutting; jet cleaning; and safety aspects. Nine of the papers are abstracted separately.

54445 Hydraulic borehole mining of coal. Cheung, J.B. pp vp, Paper D3 of Proceedings of the third international symposium on jet cutting technology. Cranfield, Eng.; BHRA Fluid Engineering (1977).

From 3. international symposium on jet cutting technology; Chicago, IL, USA (11 May 1976).

This paper presents the results obtained during the design and manufacture phase of a feasibility study of the hydraulic borehole coal-mining concept. The concept involves the drilling of a borehole from the ground surface to an underground coal deposit. A specially designed hydraulic borehole-mining device is lowered with the

borehole. Waterjets are used to erode the coal, and the coal slurry is transported inside the device to the surface by a slurry jet pump.

54446 Augmentation of a mining machine with a high-pressure jet. McNary, R.O.; Blair, J.R.; Novak, D.D.; Johnson, D.I. pp vp, Paper D2 of Proceedings of the third international symposium on jet cutting technology. Cranfield, Eng.; BHRA Fluid Engineering (1977).

From 3. international symposium on jet cutting technology; Chicago, IL, USA (11 May 1976).

Underground coal cutting tests for the purpose of monitoring respirable dust levels were performed with a boom-type mining machine in which the mechanical action of the bits was augmented by a high-pressure water jet. The respirable dust was reduced by the action of the jet to levels less than 2 mg/cu m.

54447 Survey of water jet coal mining technology. Cooley, W.C. pp vp, Paper D1 of Proceedings of the third international symposium on jet cutting technology. Cranfield, Eng.; BHRA Fluid Engineering (1977).

From 3. international symposium on jet cutting technology; Chicago, IL, USA (11 May 1976).

A summary is presented of a survey of underground hydraulic coal mining technology, based primarily on literature sources from the USSR, Poland, Germany, Japan, Canada, New Zealand, the Peoples Republic of China, the United Kingdom and United States. Primary emphasis is given to the use of monitor jets with fluming, which is now being practiced successfully in the USSR, Germany, Peoples Republic of China, Japan and Canada. A review is given of the techniques used in hydraulic mining and jet cutting of coal. The coal seam conditions which are favourable for hydraulic mining are identified. Promising coal deposits for hydraulic mining are identified in the western states of Colorado, Wyoming and Washington. Conclusions are presented regarding potential advantages with respect to health, safety, productivity and economy and the needs for further development.

54448 Hydraulic coal mining machine for room and pillar applications. Labus, T.J.; Silks, N. pp vp, Paper D7 of Proceedings of the third international symposium on jet cutting technology. Cranfield, Eng.; BHRA Fluid Engineering (1977).

From 3. international symposium on jet cutting technology; Chicago, IL, USA (11 May 1976).

A hydraulic jet coal mining machine was designed for room and pillar mining using 50,000 psi jets. The instantaneous mining rate is 6 tons/min, using 8 nozzles, 0.6mm in diameter. The unit is designed for permissible use underground using electric motors as the primary power source. The total horsepower used for cutting is 1000hp, while the total machine horsepower is 1,180. The jetting units are mounted on a Goodman 968 loader, with four 5000 psi. 70 GPM pumps being mounted in the power trailer. Emergency controls are provided as well as jet pressure control, variable traverse rate, roof, floor and side wall cutting ability, and complete operator protection. The entire unit is 36 in. high, 120 in. wide and 586 in. long and weighs 38,000 lbs.

54449 Coal ploughing assisted with high-pressure water jets. Moodie, K. pp vp, Paper D6 of Proceedings of the third international symposium on jet cutting technology. Cranfield, Eng.; BHRA Fluid Engineering (1977).

From 3. international symposium on jet cutting technology; Chicago, IL, USA (11 May 1976).

Paper describes an investigation by the Safety in Mines Research Establishment into the feasibility of breaking coal with high pressure water jets. A method of combining a conventional coal plough with pulsed water jets is suggested, and a possible layout for a practical machine of this kind is discussed. Experiments were carried out in the laboratory and at an open-cast coal site with a specially constructed rig to investigate the design's feasibility. The results are discussed.

54450 Effect of jet traverse velocity on the cutting of coal and jet structure. Mazurkiewicz, M.; Summers, D.A. pp vp, Paper D5 of Proceedings of the third international symposium on jet cutting technology. Cranfield, Eng.; BHRA Fluid Engineering (1977).

From 3. international symposium on jet cutting technology; Chicago, IL, USA (11 May 1976).

A longwall water jet mining machine for extracting coal is currently being built under a Bureau of Mines contract. In the operation of this machine a set of oscillating high pressure water jets cut into the coal face at the roof, floor and at the back of the web being taken. Describes a series of experiments with dual orifice jets investigating the effect of change in jet traverse speed and included angle between the jets on coal cutting. The effects which occur when adjacent pairs of jets are oscillated 180 deg. out of phase are also described. Problems which might occur where shale or pyrite is present in the seam are illustrated with photographs. Because of less than anticipated performance, a further series of experiments investigating nozzle geometry and traverse speed have been carried out. The experimental procedure is outlined and results are evaluated by examination of the craters cut in aluminium at various stand-off distances. Jet structure is also measured by high speed photography where the jet is oscillated at up to 180 rpm.

54451 Water jet assisted tunnel boring. Wang, F.D.; Robins, R.; Olsen, J. pp vp, Paper E6 of Proceedings of the third international symposium on jet cutting technology. Cranfield, Eng.; BHRA Fluid Engineering (1977).

From 3. international symposium on jet cutting technology; Chicago, IL, USA (11 May 1976).

Laboratory tests of high pressure water jets to kerf hard rock followed by mechanical disc cutting were conducted at the Colorado School of Mines. Results predicted that an improved tunnel advance rate of several times was possible at an estimated reduction of tunnelling cost of 30 to 50 percent. A full scale water jet assisted tunnel boring machine was designed and field tested based on the laboratory findings. The field testing results are also presented.

54452 Breaking coal and rock with pulsed water jets. Chermensky, G.P. pp vp, Paper D4 of Proceedings of the third international symposium on jet cutting technology. Cranfield, Eng.; BHRA Fluid Engineering (1977).

From 3. international symposium on jet cutting technology; Chicago, IL, USA (11 May 1976).

Laboratory tests of pulsed water cannons carried out at VNIIgidrougol (Novokuznelsk, USSR) as well as field trials in the Krasnogorskaya, Polisaevskaya-Severnaya and Yubileynaya hydromines and the Kuzbass quarry have demonstrated the efficiency of the water cannons, and the "useful" specific energy when operating in sandstone. The high productivity of pulsed mining units at stand-off distances up to 2.5 to 3 m allows one to use them for both different types of headings as well as clearing operations even on steeply sloping shelves of rock.

54453 Cutting coal with the CAVIJET cavitating water jet method. Conn, A.F.; Rudy, S.L. pp vp, Paper D8 of Proceedings of the third international symposium on jet cutting technology. Cranfield, Eng.; BHRA Fluid Engineering (1977).

From 3. international symposium on jet cutting technology; Chicago, IL, USA (11 May 1976).

The potential economic, health, and safety benefits associated with using water jets to cut coal are well known. For many applications (for instance concrete drilling, defouling and missile propellant removal), cavitating water jets have proven capable, at lower pump pressures, of providing comparable or improved rates of cleaning and cutting. These results motivated the ongoing study described in this paper, which has the ultimate objective of building and testing a prototype coal mining device using the CAVIJET (cavitating water jet) method to cut the coal in underground seams. A laboratory study is now underway to establish the system and operating parameters for a CAVIJET coal cutter. The existing facility has been modified by the construction of a larger test chamber to permit the use of specimens consisting of several coal segments imbedded within concrete and surrounded by steel compression members to provide some simulation of the in situ conditions. Some of the preliminary test results are described, and comparisons made with the results from coal cutting with non-cavitating jets. The influence of parameters such as nozzle size, pump pressure, and translation velocity on the CAVIJET rates of coal cutting is also discussed.

54454 How operational gaming can help with the introduction of a new technology. Sloman, M. *Oper. Res. Q.;* **28**: No. 4, 781-793(1977).

This paper describes the Operational Research contribution to the problems related to the introduction of seismic exploration methods into the coal industry. The OR team was able to adapt a well-established operational gaming technique to determine when seismic exploration is worthwhile and assist in the design of the seismic survey itself.

54455 Heavy surface equipment: industry problems and solutions. DeMao, P.R. (AMAX Coal Co., Indianapolis). pp 18p, Set No. 10, Paper 3 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Prior to and including the early 1970's, the demand for large mobile excavating equipment was relatively limited and very cyclical. The surface coal mining and heavy equipment manufacturing industries made a quantum technological leap in this period--which in retrospect seems to have unfortunately worked somewhat to their disadvantage. Total coal demand and total requirements for surface equipment (in terms of number of units) were relatively stagnant. The effects of this problem were devastating: in 1970, the manufacturing segment had been reduced to a handful of suppliers, with the

only ones enjoying reasonable health being those that had product lines dedicated to other industries besides mining, particularly construction and materials handling. The Arab oil embargo of October 1973 has changed the heavy surface equipment industry, as well as drastically affecting the mining industry itself. Nearly overnight, the demand for this equipment reached explosive and unprecedented levels. Over a billion dollars (in 1973/74 dollars) were committed in the 1973/74 period, causing machinery order backlogs to reach out five years in manufacturer schedules. Since the oil embargo of 1973, the mining industry has been beset with a number of opportunities and problems caused by inflation, shortages of supplies (fuel and blasting), growth requirements, capital attraction, legislation, world market/supply imbalances, and so on. It certainly didn't need any additional problem burdens generated by its heavy equipment suppliers. Because in the past the mining industry had enjoyed good products, service, and response to problems, it really didn't expect any unpleasant surprises from the manufacturers. Unfortunately, this was not to be the case, and a number of heavy equipment-related problems have developed for the operators, which are described.

54456 Haulage system changes at the Sierrita property. Schweitzer, F.W. (Duval Corp., Tucson, AZ). pp 11p, Set No. 10, Paper 4 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

The ore conveyor system consists mainly of 4 new belts and 1 which is part of the old ore system. The total length of the system is about 19,000 ft., of which 16,000 ft. is new conveyor. The new conveyor has 60" belt running at 830 feet per minute. It has a maximum capacity of 6400 tons per hour. The system was designed to average 4800 tons per hour at a conservative operating time of 75%. There is a scheduled shutdown for maintenance for 1 shift a week. The belting is Goodyear steel cable belt of all-rubber construction with no fabric in the carcass. The tension ratings selected were 3100 P.I.W. and 1450 P.I.W. The load idlers are 35 degree troughers of heavy duty construction with 7 inch rollers. They are spaced at 5 ft intervals except on vertical curves where closer spacing is used. The return idlers are 10 degree vee type spaced at 20 ft. intervals. The only training idlers used are Hewitt-Robins hydraulic trainers located on the return strand just before the tail pulley. The trainers are intended to center the belt before it goes into the loading zone. The combination of vee returns and the rigidity of the steel cable belt has done a good job on alignment. The conveyor frames are 40 ft long except for shorter frames used on convex vertical curves. Each frame is bolted to 2 wooden cross ties and then set unanchored on the graded conveyor route. Frames set in this manner have been stable and require very little adjustment. They are also easy to level or align quickly.

54457 Pit slope manual chapter 3. Mechanical properties. Gyenge, M.; Herget, G. Ottawa; CANMET (1977). 87p.

Guidance is given on the procedures required to obtain adequate knowledge of the mechanical properties of the soils and rocks which constitute the walls of the pit. The reason why certain data is necessary is explained and the tests required to obtain these data are described.

54458 Pit slope manual supplement 2-3. Geophysics for open pit sites. Herget, G. Ottawa; CANMET (1977). 25p.

This report gives an overview of surface and borehole geophysics methods useful in evaluating the distribution of rock and soil types and of rock fractures at open pit sites. The section on surface geophysics concentrates on simple do-it-yourself methods, whereas the section on borehole geophysics dwells upon services provided by geophysical service companies and their charges.

54459 Thermal convection and ventilation of workings. Chiantello, P. *Bull. Tech. Mines Fer Fr.;* 171-186(1977). (In French).

This paper discloses information which will enable immediate practical improvements to be made in the ventilation of dead ends and locations where diesel engines are used. Describes conditions in which the investigations were carried out in order to determine the different means of ventilation and the different sorts of pollution, in relation to a series of factors, in particular to the geometry of the site, to the ventilation flow rate and to the cause of the pollution. The CO and NO/sub x/ content and temperature were recorded by remote measuring devices. The number of observations is still too low for any laws to be formulated with sufficient scientific strictness. (In French)

54460 Estimation of roof stability in narrow openings and production workings: classification of rocks in the Olkusz region. Tokushi, S.; Sepial, J. *Gornictwo;* **1**: No. 3, 247-255(1977). (In Polish).

Lithological formation and structure of the rock body, strength and rheological properties of the rocks, structural faults, mining technology employed and type of support used in the mine workings all influence roof stability. Change of roof stability in the workings takes place in four phases, each exhibiting characteristic signs. A model of the rock body is presented from which both the dimensions of extraction panels and the maximum width of roadways and chambers may be determined.

54461 Principles of the stage by stage design method for the development of a coal mine. Grun, W.D. *Gornictwo;* **1**: No. 3, 217-227(1977). (In Polish).

It is suggested that, when considering the dynamic changes taking place in every working mine it becomes increasingly obvious that the application of static and determined extrapolation, academic conceptions, information and mathematical description of costs for the design of mines, taking a time horizon of from 30 to 50 years or more ahead of the moment of design decisions is unsound. The method of design and development of a mine by stages is proposed. The mine quality and quantity parameters once established must not be treated as binding during the whole extraction life; there are, however, certain time intervals (stages) within the limits of which the basic technology parameters may remain unchanged without having any adverse effect on mine performance. In the course of mine development, periodical reconstruction work, modernisation etc. is carried which, in effect, divides the work into stages. The crucial decision in stage by stage design is to determine the optimum moment for concluding one stage and starting the next. From the investigations conducted, it was found to be from 15 to 20 years. Mathematical formulations of tasks for stage by stage design are examined applying the procedure of dynamic programming.

54462 Method for determining distribution of vertical stresses in hydraulic stowing in the vicinity of a longwall face by considering variations in Poisson's ratio. Korman, S.; Mikos, T. *Gornictwo;* **1**: No. 3, 239-246(1977). (In Polish).

Displacement of rocks into the mine workings in hydraulic stowing areas is a problem which has for long been the subject of theoretical and practical study by mining engineers. From theoretical postulations, model tests on equivalent and elastooptical materials, and also from observations and measurements conducted in situ, it appears that the compressibility of the stowing mixture has a substantial influence on the distribution of stresses and strains and also on the displacement of rocks into the mine workings. A new method for determining the distribution of vertical stresses in hydraulic stowing in the vicinity of a longwall face is described. This method takes into account the variations in Poisson's ratio for the stowing material with increase in vertical pressure. The method described may also be applied for determination of stress distribution in dry stowing, in caved sectors and in a seam under extraction, on condition that convergence measurements and certain laboratory measurements are made.

54463 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977). vp. (CONF-7709124—).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

The 1977 Mining Convention of the American Mining Congress was held in San Francisco, Sept. 11 to 14. Thirty-two papers concerned with coal mining, mining equipment, legislation (dealing with environmental effects, waste disposal, etc.), land reclamation, and uranium deposits have been entered individually into EDB and ERA; ten of the papers were selected for EAPA. (LTN)

54464 Production capability of surface and underground coal mining machinery. Knight, H.E. (Pittsburg and Midway Coal Mining Co., Denver). pp 14p, Set No. 3, Paper 1 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

The productivity of surface and underground coal mining equipment is discussed from several aspects: maintenance, scheduling, reliability, priority, etc. Actually, productivity per man day declined appreciably between 1969 and 1976 (45.5 percent for underground mining and 25.6 percent for surface mining). Most of this decrease in productivity is ascribed to the 1969 Health and Safety Act and other controls and regulations. The average productivity is regarded as about 4 percent of the theoretical capacity of the mining equipment and 12 percent of the record output. Certain aspects of operations research in planning coordination of mining equipment, machine reliability effects when operating several machines in series, optimium equipment size, etc. are discussed. (LTN)

54465 Update on slurry transportation from face to cleaning plant. Dahl, H.D. (Continental Oil Co., Ponca City, OK). pp 10p, Set No. 3, Paper 3 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

We expect several benefits from this hydraulic transportation system. One, of course, is a reduction in capital requirements. In addition, the logisitics of removing coal from the mine will be simpler and more reliable with fewer production bottlenecks during peak operations. But the major advantage we forecast relates to health and safety. Hydraulic transportation has several inherent safety and health advantages. First is a great reduction in the amount of moving equipment underground. A large percentage of mine fatalities and injuries is associated with present-day conventional underground transportation equipment, most of which would be eliminated by hydraulic transportation. Second is the reduction of the danger of mine fires. The high-current trolley wire now needed for most conventional haulage equipment will be eliminated. Third, the possibility of dust explosions will be sharply reduced. Fourth, all electrical cables will be integrated with the flexible rubber hose system. Mechanical wear and abrasions will be reduced, and handling cables manually in the face area of the mine will be eliminated. Fifth, the health problem of airborne dust at transfer point areas will be eliminated, since no dust will be generated at transfer points within the mine away from the face. Sixth, dust and gas control at the face will be improved. Seventh, hydraulic transportation will replace the cars and belts which often require wider passageways than would otherwise be necessary. Not only will narrow passages be more economical in many mines, but they will permit improved roof control and reduce the incidence of roof falls.

54466 Automated extraction system using a continuous miner: operating results. Karlovsky, J. Jr. (National Mine Service Co., Nashville, IL). pp 15p, Set No. 3, Paper 5 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

The basic design features, aboveground testing, and operating results are presented for the Automated Extraction System (AES) designed to help fill many needs present in the Mining Industry. A brief description of the design and the results of underground operations, as well as the relationships between these factors, are reviewed. The AES is designed to help overcome many of the problems now prevalent in underground coal mining as a result of the Federal Coal Mine Health and Safety Act of 1969, which imposed greater regulations on roof control, clean-up, ventilation, dust suppression, methane detection, lighting, and, last but not least, operator protection. The design was directed towards producing a machine that will permit more continuous operation and greatly improve operator safety. The machine is a full-face, drum-type, continuous miner which includes self-advancing, continuous temporary roof support and onboard roof bolters to allow the installation of permanent roof support. Onboard self-advancing face ventilation, dust suppression, and air scrubbing equipment are also included in the design. In an effort to take a step forward towards automated, remote control, continuous miners, an automatic programmed cutting cycle control system is incorporated in all mining functions including movement of the roof support system and handled by this automatic system.

54467 Solving problems in mine equipment maintenance. VanDelinder, M.D. (U. S. Steel Corp., Mt. Iron, MN). pp 13p, Set No. 10, Paper 1 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

In summary, to try to overcome some of our maintenance problems, we have: organized the maintenance effort as part of the production group and included production people in the maintenance program; required production supervisors to participate in the preventive maintenance program; required maintenance supervisors to get involved in field decisions; stressed equipment availability and utilization as primary objectives for maintenance and production supervisors; included specialized people, such as planners, expeditors, and engineers in the field maintenance groups; entered into an extensive apprentice program to train mechanics; expanded the concept of spare major components to reduce downtime of the production units; and expanded the use of computers for record keeping, scheduling, and inventory control.

54468 Two-wire control of conveyor systems: application of hard-wired logic and two-wire control to mine processing and handling. Thomas, F.E. (Westinghouse Electric Corp., Beaver, PA). pp 10p, Set No. 10, Paper 2 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

New control systems now available for mining utilize solid state devices instead of relays. But the purpose of the solid state controls is not just to duplicate the job of relay systems, but rather to expand their capability beyond mere control. Solid state devices are capable not only of providing sequential logic, but also of monitoring the system, annunciating problem areas, to greatly simplify trouble-shooting. There are currently four types of solid state control available: Solid state hard-wired logic, programmable controllers, computers, and 2-wire control and monitor systems. Two-wire control and monitor systems, like the Westinghouse NL-500 system, are relatively new creations. With these systems, it is possible to command over 2000 motor starters, and monitor over 2000 inputs like limit switches or panic switches, over just two wires at distances up to 10 miles. Here's how it operates. A master station at a central control location communicates through remote stations to all devices being controlled or monitored. It uses a binary word system, computer language, to communicate both ways. When the master station is not sending a command, it remains in the monitor mode, constantly reporting on the status of every control point throughout the system. For mine processing and handling, the optimum combination of safety, productivity, and cost benefits comes about with a system combining hard-wired logic and two-wire control. In this combination, the hard-wired system performs the actual control functions, while the two-wire system performs the remote control, along with the annunciator function. Integrated systems such as this can be found in at least five mining operations already.

54469 Terminology of remote control and automation in mining. Burton-on-Trent, Eng.; Mining Research and Development Establishment (1977). 103p.

Published by MRDE for the Major Development Committee: Compehensive Monitoring. Definitions are given for over 1000 terms used in the field of automation applied to the coal mining industry.

54470 General review of the world coal industry, progress report No. 1. Muir, W.L.G. High Wycombe, Eng.; Coal Industry Information Service (1977). 54p.

Contents include energy forecasts; national strategies; the use of new technologies; the coal trade, giving production figures, exports, costs, prices and inflation indices. Reviews the coal industry in Europe, North America, Central and South America, South Africa, and Australasia, and Asia.

54471 Visit to the USA. Thomas, Y. *Bull. Tech. Mines Fer Fr.;* No. 126, 9-18(1977). (In French).

This paper presents some notes on the coal mining exhibition in Detroit and the symposium on the technology of cutting jets held in Chicago. The conference covered the control of respirable dusts; hydraulic coal mining; use of pulsed jets; influence of the transverse speed and the structure of the jet when cutting coal; coal ploughs aided by high pressure jets; preliminary work on the development of cutting jets for boring; and development of a rotary-percussive drill with high pressure jets for tunneling. Some visits to mines are also described.

54472 High speed cutting jets. Varnier, J.C. *Bull. Tech. Mines Fer Fr.;* No. 127, 143-156(1977). (In French).

This paper examines the applications of cutting jets in the mining industry. Tests carried out in the UK on the hydraulic cutting of Lorraine iron ore and possible applications of this technique in France are described. Three translations (into French) of papers given to the Chicago congress on cutting using high pressure jets are included: Cutting and breaking materials using high pressure jets, by K.

54473 Roof reinforcement using wood resin bolts. Bedmarek, W.; Papierz, A. *Wiad. Gorn.;* 305-311(Oct 1976). (In Polish).

Wood bolts with resin along their whole length were used to reinforce the roof in a thick seam which was being taken in several cuts using hydraulic stowing. This method is being developed further.

54474 Study of rock pressure distribution on a supporting beam under an artifical roof in No. 3 seam at Valia Jiului. Marian, I. *Mine, Pet. Gaze;* **27**: No. 3, 109-113(Mar 1976). (In Romanian).

By means of hydraulic transducers distributed on a 2600mm long supporting beam, the rock pressure has been measured on a longwall with a wire mesh artificial roof. A parabolic distribution of rock pressure has been established which is very close to a linear form, with values of approximately 100 daN at the end of the beam nearer the face, and approximately 400 to 500 daN at the end nearer the gob.

54475 Effect of the abutment pressure of pillars on the stability of the intermediate strata. Abashin, P.A. *Sov. Min. Sci. (Engl. Transl.);* **12**: No. 1, 72-78(Jan 1976).

This paper discusses the problem of mines working parallel beds, with particular reference to the Krivoi Rog basin. 85 rooms were surveyed and the ratio of normal thickness to size of the room along the strike was calculated. The ratio was found to increase with

a decrease in the working depth. A mathematical analysis of pillar stability is also given.

54476 Examination of the phenomenon of deformation and spalling of the coal face in some workings in the Tatabanya coalfield. Hullan, J. *Publ. Hung. Min. Res. Inst.;* No. 19, 85-91(1976). (In German).

This paper describes the progress of forward movement and spalling of the face in three faces in the Tatabanya brown coalfield, and suggests a way of reducing it.

54477 Water consumption of automatic fire extinguishers using water. Ovari, G. *Publ. Hung. Min. Res. Inst.;* No. 19, 105-119(1976). (In French).

Paper discusses water requirements for extinguishers used to fight fires in underground roadways and shafts; to extinguish fires at the place where they start. The results of experiments carried out in a gallery are reported.

54478 139th annual report of the Department of Natural Resources of the Province of New Brunswick for the year ended 31 March 1976. Fredericton, New Brunswick; Government of the Province of New Brunswick (1976). vp.

This report includes the Deputy Minister's report, reports of the lands, forests, fish and wildlife, mines, mineral resources, and forest extension services and describes the administrative services and forest districts. Mineral production and details of mining activity, including coal, are described.

54479 Blending of substandard-quality coal through production scheduling for strip coal mines. Megeath, J.D. Golden, CO; Colorado School of Mines (1976). 118p. University Microfilms Order No. 78-02,786.

Thesis (Ph. D.).

Major legislative restrictions have been placed on the burning and mining of coal. These legislative restrictions have increased the concern, on the part of coal mine operators, for careful and accurate production scheduling to obtain marketable coal. This work develops a model, and a solution procedure, for production scheduling for strip coal mines common to the western United States. The developed model and procedures are much easier to use than currently available techniques. In addition, the solution procedures, when applied to the special case of two simultaneous stripping activities, do not necessarily require extensive computer facilities. Because of the demand for increased domestic coal production, it is anticipated that this work will be of current and practical value to strip coal mine operations.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 54267

54480 (FE—2475-9) Review of industrial size reduction equipment used in the processing of coal. Bevan, R.R. (Kennedy Van Saun Corp., Danville, PA (USA)). Jul 1977. Contract EX-76-C-01-2475. 151p. Dep. NTIS, PC A08/MF A01.

The various industrial coal size reduction devices are reviewed with emphasis upon the throughput rates, power requirements and product size consist. Throughput rates are dependent upon the grindability of the material, flow characteristics of the material, the reduction ratio and efficient feeding of the device. The power draw of a given unit increases as the reduction ratio is increased or as the grindability of the material increases. Translation of size consist appears to be an acceptable method of predicting the expected product size consist if an estimate of the distribution modulus can be determined from a typical size consist. In selecting a given device for a particular application, ample consideration must be given to other coal feed characteristics such as moisture and fines content. Consideration must also be given to the reduction ratio attainable for a particular unit.

54481 (PB—276165) A preliminary feasibility study of steam coal slurry marine transport systems. Final technical report. Roseman, D.P.; Tomassoni, C. (Hydronautics, Inc., Laurel, MD (USA)). Apr 1977. Contract MA-6-38072. 150p. NTIS PC A07/MF A01.

The anticipated increase in the export of steam coal from the United States provides an opportunity for establishing advanced handling and transport systems to serve the new markets. This study investigated the feasibility of using a coal-water slurry system to move the commodities in question. A specific export opportunity, from the U.S. to a new Mediterranean power plant, was investigated in detail. The study found that the use of slurry technology was technically feasible and offered the advantage of rapid loading and discharge rates, the ability to operate at offshore terminals and the elimination of air pollution during loading and unloading operations. The major disadvantages were found to be the requirements for large quantities of fresh water and the inherent problems of dewatering for both the ship loading and the power plant receiving portions of the system. The use of converted ships for the slurry trade were also studied. Converting a 225,000 DWT VLCC and an 80,000 DWT OBO were both found to be feasible, and the freight rates were found to be competitive.

54482 (PB—277408) Physical coal cleaning for utility boiler SO_2 emission control. Final report Jul-Dec 77. Hall, E.H.; Hoffman, L.; Hoffman, J.; Schilling, R.A. (Battelle Columbus Labs., OH (USA)). Feb 1978. Contract EPA-68-02-2163. 112p.

The report examines physical coal cleaning as a control technique for sulfur oxides emissions. It includes an analysis of the availability of low-sulfur coal and of coal cleanable to compliance levels for alternate New Source Performance Standards (NSPS). Various alternatives to physical coal cleaning (such as chemical coal cleaning, coal conversion, and fluidized-bed combustion) are also examined with respect to alternate NSPS. Electric power supply and demand through 1985 are reviewed, as well as the technology, cost, and environmental overviews of physical and chemical coal cleaning techniques. Since the report deals with engineering analyses of available data and several technologies in design stages, references are somewhat limited. Descriptions of the methodologies used and the sources of information are given in lieu of referenced published data in many cases.

54483 Briquetting solves some problems. Ghosh, P.C. *Mine Quarry;* 7: No. 5, 46(May 1978).

Some recent applications of briquetting to Indian lignite are described. Raw lignite containing some 52 percent moisture is mined by opencast methods and sent by belt conveyor to a briquetting plant. The mined lignite is first crushed and screened to 0-8mm size in a closed circuit. The sized material is next dried in rotary steam driers to the range 10 to 12 percent moisture. The dried mass is then briquetted without any binder in quadruple extrusion presses; pressure up to 1000 Kg per sq cm is applied. The briquettes are then carbonized in Lurgi internally heated carbonizers at about 600°—700°C for the the production of smokeless domestic fuel. A higher temperature of about 900°C is used for producing low-volatile metallurgical char briquettes. The carbonized material is then screened. The + 10 mm material is called Leco and sold as both domestic fuel and reductant for the metallurgical industry. The undersized material called Char Fines is used as fuel in the cement, brick, lime, calcium-carbide industries. Other examples of briquetting are described briefly.

54484 Theory of flocculation. Moss, N. *Mine Quarry;* 7: No. 5, 57-61(May 1978).

The efficiency of solid/liquid separation may be greatly improved by the application of synthetic polymeric flocculants, particularly in coal preparation where sedimentation, filtration and centrifugation processes are extensively used. This improvement is achieved by bringing dispersed particles together increasing the effective particle size of the solid phase. The stability of the suspension is broken and the liquid phase is released. Most flocculants and filter aids in use today are synthetic polymers based on repeating units of acrylamide and its derivatives, which may contain either cationic or anionic charges and are available in a wide range of molecular weights and ionic charge. The term flocculation is often confused with coagulation, although the two refer to quite different processes. Coagulation is basically electrostatic in that it is brought about by a reduction of the repulsive potential of the electrical double layer. Flocculation is brought about by the action of high molecular weight materials such as starch or polyelectrolytes, where the material physically forms a bridge between two or more particles, uniting the solid particles into a random, three-dimensional structure which is loose and porous.

54485 Newcastle's 4000 t/h port facility will enhance coal export prospects of Australia. Planner, J.H. *Braunkohle;* **30**: No. 1/2, 27-34(Jan 1978).

Completed at a cost of approximately 90 million, the new coal-handling and shiploading complex at Port Waratah, New South Wales, Australia, provides Newcastle with world-class facilities. 750,000 t coal can be stored for export, and the whole facility is designed for a port throughput of 20 million tonnes per year. The two shiploaders each have a capacity of 2,000 t/h. Furthermore, there are two rail-mounted bucket wheel reclaimers. The entire installation also includes three rail-mounted stackers, a 1,500 t rail receival hopper and extensive conveyor systems. Designed primarily for the handling of coal received by rail, the complex is served by a balloon rail loop which includes a system for the discharge of 77 t capacity railway wagons on the move to facilitate a quick turn around. The building and operation of this complex are described in detail.

54486 Soviet experience in cleaning fine coal and slurry control. Belovolov, N.W. *Przegl. Gorn.;* **33**: No. 11, 521-526(Nov 1977). (In Polish).

Practical methods of cleaning fine coal in three-product dense medium cyclones and in jigs are discussed. The basic technical parameters of the machines and the reagents used in the flotation process are given, including slurry—water circuits.

54487 Small-coal washing systems. Mason, R.; Bird, D.A. *Mine Quarry;* **6**: No. 10, 12-18(Oct 1977).

The results of trials of a Concenco double deck concentrating table at Newstead Colliery coal washery are reported. Triple deck Wilfley tables were installed, and experience with these and with the rest of the modified coal preparation plant is described. Commissioning of the plant is also discussed.

54488 Low-temperature oxidation of coals and storage problems. Petrik, G.J. *Khim. Tverd. Topl.;* No. 4, 16-21(Jul 1977). (In Russian).

Since the low-temperature oxidation which occurs during open-air storage of coal is associated with appreciable loss of fuel, the "trench method" should always be used to control gas exchange.

54489 Mechano-chemistry of coals. Levedev, V.V.; Nikonorova, L.P. *Khim. Tverd. Topl.;* No. 3, 99-103(May 1977). (In Russian).

Mechano-chemical reactions can occur between mineral and oranic components of coal during grinding. When a Gorlovka anthracite was subjected to vibro-grinding for 30 minutes its total combustion temperature in excess air fell by 100 deg as compared with anthracite ground to 0 to 2 mm. The results of grinding a brown coal/ferrous oxide mixture are reported. This research into the mechanically-assisted activation of coal and metal oxides might lead to new methods of coal processing or metal recovery.

54490 Industrial experiment in continuous measurement of moisture in mixtures used in making agglomerates. Galen, L.N.; Pihen, P. *Cent. Doc. Sider. Circ. Inf. Tech.;* No. 7/8, 1603-1619(1977). (In French).

Tests carried out at Rombas and Haggondange, in collaboration with IRSID using the PIER infra-red sampler are described. Continuous information concerning the humidity of the mineral/fuel mixture permits the use of a lower moisture level which assists proper granulometric control. Describes the working principle of sampler, its practical construction, the apparatus and directions for use. The automation of moisture control is discussed.

54491 Large scale pipeline transport of energy products. Papageorges, D. *Rev. Belge Transp.;* No. 1, 3-11(1977). (In French).

Compares various methods of transporting coal, oil, gas and electricity across continental land masses. The characteristics of each type of transport are discussed. The transport costs per calorie of pipelining gas, oil and coal are assessed.

54492 Method and device for coal preparation. Smith, C.D.; Keller, D.V. Jr. (to Otisca Industries Ltd.). German(FRG) Patent 2,612,441/A/. 14 Oct 1976. 95p. (In German).

Ballast parts of coal are separated in a gravity separation process. Fluorine chlorine hydrocarbon derivates of methane and ethane, preferably trichlor-fluoromethane, are used as separating liquids. These separating liquids are characterised, apart from their great purity, by the fact that they are chemically inert with respect to normal constructional material such as mild steel and rubber, and also w.r.t. coal. Further advantages of the fluoro-hydrocarbons lie in fact that they can be used for coal with a high water content, and that their specific weight can easily be changed by changing the pressure and temperature at the gravity separating bath, or by the addition of light natural oil fractions. Compared to other separating liquids, their viscosities and surface tensions are low. Coal of very different grains sizes (0.004 to 15 cm) can be prepared by this process. Apart from pyrites sulphur, water and organically bound sulphur are transferred to the sinking route. Because of their low viscosity, fluoro-hydrocarbons are also suitable for impregnating coal with additives (e.g. CaO), by adding a binder to increase resistance to dust formation and to increase the resistance to water by adding crude oil or bitumen. The separating liquid is separated out either by evaporation or by blowing air through the coal and is liquified by compression.

54493 Dewatering flotation tailings on disc-type vacuum filters. Kontorovich, V.E. *Coke Chem., USSR (Engl. Transl.);* No. 10, 5-6(Oct 1976).

Tests carried out to determine the efficiency of the filter were based on the disc rotation rate, solids in the feed, and throughput rating. Vacuum was held between 470 and 500 mm Hg during the tests. The results showed that the minimum throughput (0.22 t/h.sq.m. surface area) was an improvement on conventional tailings treatment. The discs become more effective, the higher the solids component in the feed. Up to 48% of the coarse component is trapped, the remainder being rejected into the sludge trap.

54494 Constructional systems for heat recovery and storage. Sabady, P.R. *FI-Bau;* **11**: No. 3, 16-22(1976). (In German).

A report is given on the historical development of energy-saving buildings as well as solar houses which were already built at the end of the Thirties in Anerica, Europe, and Japan. The principles of the systems are dealt with, they consist of solar collector, circuit, storer, and distribution circuit. The systems are subdivided and defined according to energy conversion, storage material and heat transport medium. A total of eight systems and variants and their function are described, simutaneously giving data on the objects built. Finally, planning aspects for functionally correct buildings forms and for purposeful integration of collector surfaces are presented.

COMBUSTION

REFER ALSO TO CITATION(S) 54286, 54327, 54347, 54352, 54355, 54435, 54618, 54619, 54620, 54621, 54899, 54922, 54939, 55745, 55746

54495 (AD-A—050408) **Ignition of fuel sprays by incendiary metal particles. Final report 1 Jun 76—30 Sep 77.** Sirignano, W.A.; Homan, H.S. (Princeton Univ., NJ (USA). Dept. of Aerospace and Mechanical Sciences). Dec 1977. 38p. NTIS PC A03/MF A01.

The objective is to provide experimental and theoretical studies which lead to minimization of the fire hazard due to ignition of fuel sprays and vapors by clouds of incendiary metal particles. A literature review shows that much qualitative information is available on this problem, but systematic experimental studies are few. Most of the previous research was in search of 'spark-proof' tools and explanations for coal mine explosions. In general, the metals with higher melting temperature provide the most incendiary sparks from abrasion. Numerical modeling of ignition of a stoichiometric fuel-air mixture by a hot, inert, particle has been completed. The preliminary results show that non-burning used to describe the effects of finite amplitude propagation on the axial time waveforms. A precise theory for the diffraction of the head shock was also presented. The experimental measurements generally confirmed the theoretical predictions.

54496 (FE—2489-22) **Development of combustion data to utilize low-Btu gases as industrial process fuels. Project 8985 special report No. 1, forward-flow burner type.** Waibel, R.T. (Institute of Gas Technology, Chicago, IL (USA)). Mar 1978. Contract EX-76-C-01-2489. 55p. Dep. NTIS, PC A04/MF A01.

Data were gathered to determine the performance of a Bloom baffle burner when retrofit with three low-Btu gases. The baffle burner is representative of the forward-flow type of burner and was fired on a furnace with a load simulating the preheat zone of a steel reheat furnace—a typical use for this burner. The low-Btu gases simulated for these combustion trials were Koppers-Totzek oxygen, Wellman-Galusha air, and Winkler air. All of the low-Btu gases exhibited problems when fired on an unmodified burner. Each had a flame length longer than the natural gas flame and a thermal efficiency lower than the efficiency with natural gas. Burner modifications could alleviate some of the retrofit problems. With these modifications Koppers-Totzek oxygen medium-Btu fuel gas would be an acceptable substitute for natural gas. The other two low-Btu gases would still not be ideal substitutes.

54497 (FE—2694-1) **Fuel extension by dispersion of "clean" coal in oil. First quarterly report, October 1977—January 1978.** Burgess, L.E. (Gulf and Western Advanced Development and Engineering Center, Swarthmore, PA (USA)). 1978. Contract EF-77-C-01-2694. 58p. Dep. NTIS, PC A04/MF A01.

Initial experimental work was performed in order to select candidate materials. Hydrous chemical grafting beneficiation will start after the selection of an aqueous molecular grafting solution. Early experimental results show that there is substantial improvement in oil-coal dispersion stability from a chemical grafting reaction of Pittsburgh seam coal with cracker gasoline monomers. This experiment must be confirmed by repeating with the same batch of cracker gasoline and another similar material. The conclusions that can be drawn at this point are as follows: Monomers for the coal chemical grafting reaction are available in sufficient quantity at the price of $.05 to .08 per pound. Slurry reactions of coal without graft initiation (GI) show limited improvement in dispersion stability due to surfactant effects. Reflux reactions with GI, using styrene monomer, show considerable improvement over reactions without GI on dispersion stability. Reflux reactions on Pittsburgh coal using cracker gasoline show substantial improvements in dispersion stability. From this initial work, there is evidence that chemical grafting may be used to improve the oil dispersion stability of coal. Much more work is required to confirm this observation.

54498 (SVF—47) **Study on ash agglomeration in a fluidised bed.** Mardsjoe, O.; Johnsson, H. (Stiftelsen foer Vaermeteknisk Forskning, Studsvik (Sweden)). Sep 1977. 81p. (In Swedish). Dep. NTIS (US Sales Only), PC A05/MF A01.

As a part of a project with a fast fluidized bed, this work dealt with ash separation from the coal. Ash agglomeration through the Godell phenomena in a fluidized coal bed and separation of the ashes through a venturi nozzle was studied. An experimental unit consisting of an approximately 1 meter high ceramic vessel with a venturi nozzle in the bottom was built, diameter of the vessel 150 mm. Fluidized bed heights up to 150 mm were tried with bed temperatures in the range of 1100—1250°C depending on the coal used. The agglomerates were separated from the coal bed by letting a current of air pass through the venturi nozzle to the coal bed. The velocity of the air in the nozzle was determined by the velocity heat of the largest coal particles in the bed. Since the agglomerates gradually increased in diameter they were capable of passing through the air stream. As a consequence of unstable air supply to the nozzle and pressure variations in the fluidized bed, velocity variations in the venturi got too big to establish a reliable operation. Based on the literature, attempts were made to determine the agglomerating temperatures from the ash analysis of a bituminous coal. While running the coal in the experimental plant deviations from the presupposed temperature were found.

54499 **Pulverizex coal arc heated igniter system.** Blackburn, P.R. (to Union Carbide Corp.). US Patent 4,089,628. 16 May 1978. Filed date 17 Feb 1976. 8p.

An electric arc heated, high velocity, oxidizing gas jet is used to ignite pulverized coal as the coal is fed in an air stream through the coal burners in a conventional coal-fired, suspension type steam boiler.

54500 **Situ coal combustion heat recovery method.** Reynolds, M.J.; Disney, R.W. US Patent 4,089,373. 16 May 1978. Filed date 4 Apr 1977. 8p.

A method for recovery of heat generated by the combustion of coal in situ within coal seams in the earth. Three embodiments are described: one, in which the coal seam crops out and into which can be drilled and inserted a pipe, through the coal seam, to a central point, where it is joined with a vertical pipe drilled from the surface. Water is supplied to the pipe at the point of outcrop. Fires are started within the coal seam and supplied with air from the surface by means of drilled boreholes. The heat of combustion converts the water in the pipe to steam which travels up the vertical pipe and is used to drive a turbine generator system. A second embodiment is used where there is an overlying aquifer above the coal seam. Fires are started by means of air supplied through boreholes leading from the surface into the coal seam. The heat of combustion converts the water in the aquifer to steam, which then is circulated out of the aquifer and up to the surface where it drives a turbine generator system. A third embodiment uses the hot combustion gases to heat water to steam in pipes in a vertical borehole.

54501 **Stabilized suspension of carbon in hydrocarbon fuel and method of preparation.** Keller, L.J. (to The Keller Corp.). US Patent 4,089,657. 16 May 1978. Filed date 16 May 1977. 12p.

A method of preparing stabilized suspension of carbon in hydrocarbon fuel characterized by comminuting coal to form predetermined sized particles and coating the particles with at least a coating of an alcohol having 1—4 carbon atoms and thereafter admixing the alcohol-coated particles with a liquid hydrocarbon to form the substantially uniform admixture for serving as a fuel. In a preferred embodiment, coal particles are first compacted and comminuted to the predetermined size range to form an abundance of platey, lenticular, irregular and angular particles for forming a stabilized suspensoid that exhibits the property of shear thinning so as to be pumpable with a lower apparent viscosity than the at rest viscosity of the slurry of carbon in hydrocarbon. Also disclosed are specific details of the method and preferred embodiments, including the fuel composition, per se.

54502 **Fluidized-bed energy technology coming to a boil.** Patterson, W.C.; Griffin, R. New York; INFORM, Inc. (1978). 140p. (TID—28617).

This report reviews the worldwide status of research, development, demonstration, and commercialization of fluidized-bed combustion. It provides usable, working knowledge for designers, users and educators. There is general agreement that atmospheric fluidized-bed boilers will be the first to establish themselves in the market, meeting the needs of industry for power and steam. Observers surveyed by INFORM feel this will almost certainly come about within the coming decade and possibly sooner. Pressurized systems of all sizes are expected to be delayed somewhat longer; again, the smaller sizes, from industrial up to small utility and co-generation uses—less than 200 MWe—are likely to make a mark first, perhaps by 1990. Full-scale utility boilers will take the longest to arrive, for several reasons. Utilities are reluctant to undertake the investment and commitment necessary when they are faced with cash-flow problems and an existing superfluity of base-load generating capacity. Future growth in electricity use is uncertain. Utilities especially want to see improvements in calcium/sulfur ratios and combustion efficiency. The scale-up of either atmospheric or pressurized fluidized-bed combustion to a size presently considered appropriate for utility use is still a significant leap beyond present experience. Government and industry are beginning to recognize both the potential and the opportunity which fludized-bed technology represents. But there remain many obstacles—especially economic and political—to be surmounted. To make the potential of fluidized-bed energy technology an actuality will continue to require initiative and courage. Some 20 organizations with major programs and 50 with smaller programs have been surveyed with respect to programs, technology, goals, opinions, financial data, etc. Addresses are included. (LTN)

54503 **Results of tests on the process of fluidization of pulverized coal.** Chaltsev, M.N. *Therm. Eng. (USSR) (Engl. Transl.);* **23**: No. 9, 60-63(Sep 1977).

The fluidization of pulverized coal was studied in the laboratory using a polydisperse coal sample. The results can be used for rough estimation of fluidization parameters for coal dust with different size composition characteristics.

54504 **Contemporary solid fuels combustion theory and ways of reducing emissions during combustion.** Delyagin, G.P. *Khim. Tverd. Topl.;* No. 3, 82-87(May 1977). (In Russian).

This paper reviews the theory of combustion, and the ways of burning coal which reduce the emission of pollutants, particularly fluidized bed combustion.

54505 **Design of perforated distributor bases for gas fluidised beds.** Fooks, K.J.; Wheeldon, J.M. London; Coal Research Establishment (1976). vp.

The minimum pressure drop across the distributor base of a fluidized bed necessary to ensure an even flow of fluid over the entire cross section of the bed is not well defined. Neither is the method for designing the distributor base to achieve such a pressure drop, once decided upon. Recommends a minimum base pressure drop and a design procedure for the accurate mechanical design of perforated distributor bases. Experiments carried out to assist in the development of the design procedure are presented.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 55290

54506 (EPRI-EM—695(Vol.1)) **Assessment of fuels for power generation by electric utility fuel cells. Final report.** Stickles, R.P.; Interess, E.; Kittrell, J.; Moncrieff, T.I. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Mar 1978. 192p. Dep. NTIS, PC A09/MF A01.

This study assesses the technical and economic feasibility of alternate fuel options for dispersed and baseload utility-scale fuel cell power plants. The assessment covers coal-derived and petroleum-derived fuels, and near-term and advanced fuel conversion and fuel cell technologies. A forecast of international crude oil prices over the period of 1980 to 2000 is developed. Three oil-based dispersed fuel cell and six coal-based central fuel cell power plants were characterized in terms of process conditions, energetics, and cost. The projected prices and availability of naphtha for first generation dispersed fuel cells are favorable based on the forecasted incremental demand profile for petroleum products. The optimum sulfur level for refined petroleum products purchased for dispersed fuel cells is order-of-magnitude 200 ppM sulfur. Molten carbonate fuel cells integrated with near term coal gasifiers show promise for economical and efficient baseload power generation. Synthetic liquid fuel derived from coal is not competitive with petroleum-derived fuels in the 1980 to 1990 time frame.

54507 (EPRI-EM—695(Vol.2)) **Assessment of fuels for power generation by electric utility fuel cells. Final report.** Stickles, R.P.; Interess, E.; Kittrell, J.; Moncrieff, T.I. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Mar 1978. 315p. Dep. NTIS, PC A14/MF A01.

Volume 2 contains two appendices: fuel availability and price forecast and fuel-to-power system definition. (LK)

54508 **Coal trade will double by mid 80's.** *Coal, Gold Base Miner. South. Afr.;* **26**: No. 5, 73, 75, 77, 81(May 1978).

World coal trade is expected to double by the mid-1980s with trade in steam coal growing rapidly by 1985 and becoming the principal growth sector in coal trade in the longer term. Although world coal production might double by the end of the century, the greater part of the increase will be for internal needs rather than for

world trade. Apart from logistical problems associated with plans for rapid development of world coal production, the growing pressure of domestic demand among the traditional coal exporters of the developed world could restrict export availabilities. Although coking coal represents only about 20% of the world coal production, it dominates world trade in coal. Coking coal output in recent years has been about 475 million tons a year with the main producers being the CPE (Centrally Planned Economy) countries (35%) and the EEC (20%). Coking coal constitutes nearly 30% of world economically recoverable coal (anthracite and bituminous) reserves, of which over half are held by the USSR and the US alone. About 90% of the coking coal consumed in the OECD (Organization for Economic Co-operation and Development) area is for the iron and steel industry and hence the future of coking coal trade is almost entirely bound up with this energy-intensive industry's future. The trade of individual countries is discussed briefly.

54509 Anthracite and antitrust. Schenck, G.H.K. *Earth Miner. Sci.;* **47**: No. 4, 25-28(Jan 1978).

The anthracite industry has a history of price fixing and dominance by a few firms. Control of anthracite prices meant that vendors of oil and gas had stable prices to compete against. As a result, these vendors only needed to learn what price differential with anthracite was rquired to get them all the new business they could accommodate. Conversely, if the anthracite industry had been competitive, the initial sales decline caused by switches to oil and gas would have produced a rapid drop in anthracite prices as each producer tried to maintain his shipments at his mine's most efficient level of output. Rapidly dropping anthracite prices would have resulted in mine closings as the least efficient operators were forced out by prices that didn't meet their costs. But the remaining competitive anthracite firms would have been operating at efficient levels that could have been near capacity. Instead, what happened. We know that prices were artificially fixed and production was allocated by the Anthracite committee, As a result, prices didn't decline much. Allocation of production quotas to all producers regardless of their costs meant that most, if not all, of them would be operating below their most efficient levels. The combined effect of substituting control for competition was higher prices, higher costs, lower production, and more rapid growth of substitutes than would have occurred without control.

54510 Future coal supply for the world energy balance. Ledent, P. Liege; INIEX (1978). 17p. (In French).

This paper discusses the IIASA conference on energy resources held in Moscow. Emphasizes several points raised in the opening debate. Resources and reserves are defined and it is noted that, in terms of coal equivalent, they are extremely high but they can vary widely according to the hypotheses used in their estimation. The development of in-situ exploitation could raise the estimates further. The prospects for surface mining are assessed and its ecological effects are considered. Problems of transporting coal are reviewed.

54511 Coal mines: reason for deficit. *Presence;* No. 6, 3-5(Jul 1977). (In French).

Charbonnages de France will receive 3300 MFF from the French government to cover the 1977 deficit. The reasons for this deficit (numbers of retired workers, low prices, and steel industry problems) are discussed.

54512 Energy producer looks at coal and oil. Warner, D.G. pp 17p, Set No. 3, Paper 4 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Energy industries, such as coal and oil, have a lot in common. We run our business with similar priorities. There are, of course, differences and chief among these is the fact that coal reserves are relatively abundant. But the coal industry faces some serious problems developing that abundant coal. We will need new technology, massive training programs for the hundreds of thousands of new workers required, and we will need equally massive doses of capital to make it all work. And we will need public goodwill. There are some things we do not need—like Federal price controls, changing regulations, increasing restrictive legislation, and divestiture. The coal industry has received a mandate from Washington to help solve our country's energy crisis, but if we are to have any chance to fulfill that mandate, Congress and the Administration must provide the policy leadership which will clear away the barriers and complexities now slowing our progress. Our greatest assets are our resources—the abundant reserves of coal and the initiative and foresight of our people. Industry, government, and the people must all work together to utilize our nation's energy and human resources efficiently. We in the coal industry are anxious to proceed with a program to provide adequate fuel resources for the future.

54513 Bituminous coal industry: a manpower forecast. Kaufman, J.J. (Cornell Univ., New York). pp 22p, Set No. 3, Paper 6 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

The model for the forecasts has been submitted to the U.S. Bureau of Mines. The computer program and data, on the basis of which the forecasts were made, are also available. If assumptions are to be modified, or if better or different data became available, it is not difficult to modify the forecasts. The real problem lies in the adequacy and reliability of the data available. We found severe limitations in this aspect of the study. It would be desirable to determine (a) the questions to be asked; (b) the model (and appropriate variables) developed; and, (c) on the basis of the model obtain adequate and reliable data. Unfortunately, this process is not followed. Usually, data are collected before the appropriate questions are asked. It is then found that the model has to be modified and adjusted to the available data. This is the problem we faced. We also found that published data by governmental agencies reflected data submitted by management and that the reliability of the data was questionable.

54514 Markets and costs for western steam coal. Bennewitz, G.A. Jr. (Denver and Rio Grande Western Railroad Co.). pp 8p, Set No. 7, Paper 2 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Western coal can find a place in the market throughout the country, provided its use is not restricted through a mandate for scrubbers, or use of local coal. Western coal is not homogeneous, that is to say all thick-seam, low-Btu, but substantial reserves of high-Btu coal exist that are compatible with some existing sources in the East, as far as load-carrying capability. As other fuels become more scarce and higher-priced, coal will be able to find a place as the fuel in cement plants, pulp and paper plants, and canneries; but the West will still be a net exporter of coal, as its coal reserves far exceed the available market in the West.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 54379, 54388, 54391, 54393, 54395, 54405, 54406, 54413, 54414, 54419, 54423, 54435, 54437, 54441, 54446, 54477

54515 Health effects of diesel exhaust emissions. *Min. Congr. J.;* **64**: No. 1, 33-38(Jan 1978).

This report summarizes a report on the health effects of using diesel equipment in underground mines. Reviews world-wide literature, identified part and continuing research programmes, and defines areas where further study may be needed.

54516 Olga Coal Company's 5 West mine fire. Stone, C.B. *Min. Congr. J.;* **64**: No. 1, 51-57(Jan 1978).

An account of firefighting at the W. Virginia mine where massive quantities of foam were injected from the surface gives information on the resulting contamination of the mine drainage water. Normally this water was used for the coal preparation plant and after filtration and chlorination as the water supply for a neighboring town. Large active carbon filters were installed to treat the contaminated drainage water before disposal.

54517 Detection of endogenous fires and extinguishing them with foam. Igishev, V.G. *Przegl. Gorn.;* **33**: No. 11, 532-535(Nov 1977). (In Polish).

The causes of spontaneous fires in the Kusnetz Basin and methods of extinguishing them, are described. Water-air foam is an efficient extinguishing agent: it markedly reduces the chemical activity of the coal and prevents air reaching the seat of the fire.

54518 Respiratory protective equipment. The nominal protection factor as an aid to selection for use. Barraclough, N. *Staub-Reinhalt. Luft;* **37**: No. 10, 369-370(Oct 1977). (In German).

The concept of the Nominal Protection Factor which is deduced from maximum permitted leakages in standard tests has found favor in Great Britain in recent years as a guide to the selection of respiratory protective equipment from the many types available. The justification and limitation of the method are discussed and the need for studies of performance in practical situations pointed out.

54519 New regulations on breathing protection apparatus and their consequences for protection, testing and use of such apparatus,

and for preventive investigations carried out by users. Fahrbach, J. *Staub-Reinhalt. Luft;* 37: No. 10, 361-368(Oct 1977). (In German).

Although European standards have been proposed or issued for the nomenclature and testing of breathing apparatus, individual countries have their own regulations on the use and testing of this equipment. Discusses the regulations which apply in various countries, devoting most space to Germany, and surveys the types of apparatus available.

54520 Influence of average dust concentration and composition in underground work places on the frequency of pneumoconiosis in miners in mines in the Ostrava-Karvina coalfield. Vitek, J. *Staub-Reinhalt. Luft;* 37: No. 8, 296-299(Aug 1977). (In German).

The risk of pneumoconiosis in underground mines in the Ostrava-Karvina coalfield is assessed on the basis of data on the average concentration and the composition of dust. The incidence of pneumoconiosis depends on the average total dust concentration. No obvious correlations were found between the average concentration of the main components of the dust and the frequency of the disease. There is very little difference between dust compositions in different mines.

54521 Health and safety research 1976. London; Her Majesty's Stationery Office (1977). 66p.

An account of the Executive's research, testing and scientific support services is incorporated in the annual report of the Safety in Mines Research Establishment.

54522 Industrial hygiene program for a surface mining operation. Davis, S.C.; Balzer, J.L.; Raymond, M.A. (Utah International Inc., San Francisco). pp 6p, Set No. 13, Paper 1 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Utah is engaged principally in mining, oil and gas exploration, development and production, and ocean shipping. The Company employs surface mining methods in virtually all of its operations. The industrial hygiene program for Utah International is a function of the Environmental Quality Department. This is an interdisciplinary group with five functional responsibilities--the physical environment, industrial hygiene, environmental studies and reports, review of legislation and regulations, and assistance with permits and license applications. Utah's environmental policy statement refers to industrial hygiene in the following manner: "Utah will comply with all applicable requirements, standards, and criteria relating to occupational safety and health." This policy allows the development of complete occupational health and industrial hygiene programs that comply with, and in some cases exceed, the legal requirements. The general guidelines to the application of this policy are that programs must be economically feasible, technically feasible, ecologically sound and socially acceptable.

54523 Underground use of dust scrubbers in European coal mines. Hoelter, H. (Hoelter Co., Gladbeck, Ger.). pp 8p, Set No. 3, Paper 7 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Experimental work on underground dust collectors began in Germany about a decade ago and resulted in development of a family of highly efficient wet collectors and just recently in a new compact dry dust collector. The purpose of this paper is to present some of the highlights of our experience.

REGULATIONS

REFER ALSO TO CITATION(S) 54356, 54512, 55238, 55241, 55288

54524 Public affairs in the coal industry. Paul, J.H. (AMAX Coal Co., Indianapolis). pp 12p, Set No. 15, Paper 3 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Public affairs at AMAX coal involves relations with employees, customers, and the general public. The government relation section attempts to work with coal associations in support of or in opposition to proposed legislation. The group has the responsibility for preparing and filing environmental permits. They also handle claims (e.g., for blasting damage). Cooperation with news media is discussed. (LTN)

54525 Toxic and hazardous substances regulations affecting mining. Harris, J.W. (International Minerals and Chemical Corp., Mundelein, IL). pp 20p, Set No. 5, Paper 2 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Increased public awareness, attention and concern has prompted congressional legislation directed toward control of recognized and potential toxic and hazardous substances in the Nations's mines, mills and factories, in the marketplace and in the environment. Such control legislation has become quite prevalent in recent years and has culminated in the Toxic Substances Control Act, Public Law 94-469, which is administered by the U.S. Environmental Protection Agency (EPA). This Act gives EPA broad authority to ban or place restrictions on the manufacture and marketing of existing and new chemical substances or mixtures which may pose an unreasonable risk to health or the environment. The Act stipulates that EPA should seek to control such risk under existing Federal laws, unless it is determined that it is in the public interest to protect against such risk by actions taken directly under the Toxic Substances Control Act. There exist a multitude of Federal laws under which the Administrator of EPA could seek to control the manufacture, processing, distribution in commerce, use or disposal of a chemical substance or mixture. This paper reviews selected sections of several of these Federal laws which may impact mining and associated industries.

54526 Impact of non-point source controls of S 208 FWPCA on the mining industry. Haggard, J.L. (Evans, Kitchel and Jenckes, Phoenix, AZ). pp 18p, Set No. 5, Paper 3 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

The S 208 program of the Federal Water Pollution Control Act Amendments of 1972 is currently in its planning and public participation phase. In most states, it will not be until 1979 or later when we can expect the plans to be implemented and the controls to be applied. It is for this reason, and for the reason that management of mining companies rightfully consider that their function is to produce minerals, that there has been very little participation by the mining industry in these early phases of 208 planning. Adding to this disinclination to become involved in the process is the problem that it is not feasible for any one person having other duties to keep abreast of the volumes of studies, reports and meetings which the 208 planning funds seem to encourage. Nevertheless, I would suggest that the investment of time now in participation by the mining industry will likely produce greater benefits later in obtaining more reasonable control requirements.

PETROLEUM

REFER ALSO TO CITATION(S) 55234, 55235, 55938

RESERVES

REFER ALSO TO CITATION(S) 54549, 54550

54527 Organicheskoe veshchestvo i neftegazonosnost verkhneproterozoiskikh obrazovanii bashkirii. (Organic matter and petroleum: gas deposits of the upper proterozoic formations of Bashkiri). Zufarova, N.A. Moscow; Izdatel'stvo Nauka (1976). 106p.

The geochemical characteristics and the conditions for the concentration of organic matter are given for the Rifeyan-Vend deposits of Bashkiri. A comparative analysis is made of the change characteristics of trace organic matter, oils, and gases in the oldest pre-Paleozoic, Rifeyan-Vend and overlying Paleozoic formations. Possible leading directed organic matter change factors are clarified for a series of vertical geochemical zonality. Oil and gas deposit prospects of the oldest sedimentary formations of Bashkiri are evaluated on the basis of an overall summarization of geological and bituminological research data. Oil and gas-producing rock and possible oil and gas accumulation zones are identified. 27 tables, 7 figures, 121 references.

54528 Prirodnye rezervuary nefti i gaza. (Natural resources of petroleum and gas). Burlin, Yu.K. Moscow; Izdatel'stvo Moskovskogo Universiteta (1976). 135p.

Contemporary concepts are presented on the formation and distribution of petroleum and gas-bearing rock. Methods of studying the properties of collector-rocks, their structure and their content of residual water are examined in detail. The book is intended for use

for the course "Natural Resources", given at the Geology Department of Moscow University. 18 tables, 53 figures, 10 references.

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 54622

54529 (SAND—78-0665C) **Status of the Offshore Technology Program.** Reece, E.W. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 9p. (CONF-780825—11). Dep. NTIS, PC A02/MF A01.

From 4. symposium on enhanced oil and gas recovery and improved drilling methods; Tulsa, OK, USA (29 Aug 1978).

The objective of the Offshore Technology Program is the development of instrumentation systems capable of collecting marine and geologic hazards data in frontier regions of the Outer Continental Shelf (OCS). Elements common to a variety of remote seafloor instrumentation applications such as acoustic telemetry, digital data acquisition, processing, and storage plus command and control techniques have been demonstrated. The design of a Seafloor Earthquake Measurement System (SEMS) has been completed and a prototype system is being fabricated for testing in the Fall of 1978.

54530 (UCID—17852) **BIFUR II, a program for calculating borehole gravity caused by two-dimensional structure.** Hearst, J.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jul 1978. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

A revised computer program, BIFUR II, has been written to compute the gravitational effect of structures describable in two dimensions by straight line segments. The primary application is to bore hole gravimetry, but surface gravity problems can also be investigated. Input is much simpler than that of the previous program by the same author, and not limited to structures bounded by vertical sides.

54531 New possibilities for direct exploration for oil and gas pools by the seismic method. Timoshin, Yu.V.; Yakubetskaya, N.I. (Scientific-Research Geological-Exploration Inst., Kiev). *Int. Geol. Rev.;* 20: No. 5, 543-547(May 1978).

Translated from Geol. Nefti Gaza; No. 4, 54-59(1977).

In order to assess the possibilities of the diffraction method during the discovery and mapping of oil and gas pools, 40 areas, including 16 well-confirmed petroleum occurrences were investigated. The construction of the seismic transforms was achieved using a combination of D- and MD-conversions based on seismograms from 6 to 12 profiles. All or part of the features indicating pools were recorded for 100% of the known pools on the seismic images. Judging from the experimental data, the characteristic features on the seismic image indicating the presence of a pool in the environment include the presence of continuously or discontinuously traced, practically horizontal boundaries among the principal boundaries with other slopes; a change in the form of the signals from the reflected wave above the horizontal boundary (inversion of the phase of reflection, dampening to zero of one of the phases of reflection, change in the signal spectrum, etc.); a change (often an increase) in the amplitude of the wave, reflected from the top of the reservoir layer in the region above the horizontal boundary; a weakening in the amplitude of the signals of the image below the water-oil contact boundary; and a change in the amplitude of the signals in the region of diffusion of the hydrocarbons from the pool. A combination of all or of a portion of the features with high probability indicates the presence of an oil and gas pool in the appropriate region of the environment.

54532 Determination of a bed's hydrodynamic parameters from operational results with KII. Shakirov, A.F.; Galyavich, A.Sh.; Nemtinov, V.K.; Samartseva, V.P. *Neft. Khoz.;* No. 3, 14-17(Mar 1977). (In Russian).

Results are listed for forecasting hydrodynamic parameters according to data from tests on drilling pipes. Those data were found to agree closely with results of borehole testing. 1 table, 1 illustration, 4 references.

54533 Carbon isotopes in petroleum exploration. Stahl, W.J. (Federal Inst. of Geosciences and Natural Resources, Hanover). *Indian East. Eng.;* No. 119, 101-102(1977).

An isotopic correlation method for source rocks and crude oils is outlined. The basis of the method is that carbon isotope rations of crude oil fractions of different molecular types (i.e., saturates, aromatics, heterocomponents, and asphaltenes) change in favor of the ^{13}C isotope with increasing polarity or polarizability of the fractions. Asphaltenes are the most ^{13}C enriched and isotopically heavier than the whole crude oil. Kerogens are isotopically heavier than the genetically correlated crude oils. Genetically related asphaltenes and kerogens are characterized by similar $\Delta\ ^{13}C$-values due to chemical and structural similarities. On the average kerogens are enriched in the ^{13}C isotope by about 0.25% +- 0.7% compared with the genetically related asphaltenes.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 54795

54534 (FE—2600-9) **Study to determine the technical and economic feasibility of reclaiming chemicals used in micellar polymer and low tension surfactant flooding. Final report.** Stephens, R.H.; Himmelblau, A.; Donnelly, R.G. (Energy Resources Co., Inc., Cambridge, MA (USA)). Feb 1978. Contract EF-77-C-01-2600. 208p. Dep. NTIS, PC A10/MF A01.

Energy Resources Company has developed a technology for use with enhanced oil recovery to achieve emulsion breaking and surfactant recovery. By using ultrafiltration membranes, the Energy Resources Company process can dewater an oil-in-water type emulsion expected from enhanced oil recovery projects to the point where the emulsion can be inverted and treated using conventional emulsion-treating equipment. By using a tight ultrafiltration membrane or a reverse osmosis membrane, the Energy Resources Company process is capable of recovering chemicals such as surfactants used in micellar polymer flooding.

54535 (NTIS/PS—78/0277) **Petroleum exploration, production, and recovery methods (citations from the NTIS data base). Report for 1964-Feb 78.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 186p.

Various methods of oil recovery such as water flooding, gas flooding, steam flooding, and thermal recovery methods are discussed in this bibliography of Federally-funded research. Also included are methods used in prospecting for oil and predicting oil recovery; production processes and costs; and mining and petroleum laws of various countries. Offshore drilling and recovery are not included. (This updated bibliography contains 181 abstracts, 41 of which are new entries to the previous edition.)

54536 (NTIS/PS—78/0278) **Petroleum recovery. Volume 2. reservoir engineering and recovery methods. 1976-March, 1977 (citations from the Engineering Index data base). Report for 1976-Mar 77.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 184p.

Thermal recovery methods and well stimulation using waterflooding, steam injection, gas injection, and fluid injection techniques are discussed in this bibliography covering worldwide research. Topic areas cover fire flooding, caustic water flooding, miscible displacement, microemulsion flooding, polymer flooding, carbon dioxide miscible flooding, control of water mobility using polymers, and heat loss calculations. Reservoir modeling and simulation studies and studies pertaining to well logging, core analysis, and well perforation are included. A few abstracts discuss techniques of determining residual oil saturation, predicting oil recoverability, and monitoring the degree of flooding. (This updated bibliography contains 177 abstracts, none of which are new entries to the previous edition.)

54537 (NTIS/PS—78/0279) **Petroleum recovery. volume 3. reservoir engineering and recovery methods. April, 1977-February, 1978 (citations from the Engineering Index data base). Report for Apr 77-Feb 78.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 218p.

Thermal recovery methods and well stimulation using waterflooding, steam injection, gas injection, and fluid injection techniques are discussed in this bibliography covering worldwide research. Topic areas cover fire flooding, caustic water flooding, miscible displacement, microemulsion flooding, polymer flooding, carbon dioxide miscible flooding, control of water mobility using polymers, and heat loss calculations. Reservoir modeling and simulation studies and studies pertaining to well logging, core analysis, and well perforation are included. A few abstracts discuss techniques of determining residual oil saturation, predicting oil recoverability, and monitoring the degree of flooding. (This updated bibliography contains 211 abstracts, all of which are new entries to the previous edition.)

54538 (SAND—78-0630C) **Materials studies for thermal, enhanced oil recovery processes.** Johnson, D.R.; Magnani, N.J. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 11p. (CONF-780825—9). Dep. NTIS, PC A02/MF A01.

From 4. symposium on enhanced oil and gas recovery and improved drilling methods; Tulsa, OK, USA (29 Aug 1978).

Corrosion, erosion and thermal stresses all place severe requirements on materials used in steam drive and in situ combustion enhanced oil-recovery processes. The status of a program initiated to identify material problems and develop possible solutions is re-

viewed. Preliminary efforts initiated in support of thermal recovery processes include: (1) a workshop to review the state-of-the-art on materials applications to steam and fire floods; (2) mathematical calculation of downhole gas compositions and the development of stability diagrams for material selection; (3) investigation of high-temperature elastomers for packer use and electrical insulation; and (4) evaluation of hard coatings for corrosive/erosive applications. The studies will be continued and extended to include structural response of materials in field environments. An effort is also under way to identify and evaluate materials of construction for equipment being developed for Project 16, DEEP STEAM. These materials include improved elastomers for packers, insulation for steam injection strings, high-temperature components for a downhole steam generator and corrosion/erosion-resistant materials for use in production wells.

54539 Run-in and tie back apparatus. Bonds, J.V. (to McEvoy Oilfield Equipment Co.). US Patent 4,093,030. 6 Jun 1978. Filed date 24 Jan 1977. 27p.

The described invention includes method and apparatus for the installation of a casing hanger supporting a string of casing down hole in an oil or gas well, for removal of the installation equipment, and for tying back the hanger to an insulated production riser extending to the surface. The casing hanger is lowered into the well on drilling casing, having a smaller outside diameter than the insulated production riser casing, to permit a sufficiently large annulus for the passage of fluid between the drilling riser and the previously installed drilling riser. The drilling riser is removed by disconnecting it from the hanger by clockwise rotation of the drilling riser. The insulated production riser casing, or other special riser pipe, having a larger outside diameter than the drilling riser casing, is used to tie back with the hanger where standard riser casing is not suitable for the production of oil or gas, e.g., in the case of production through permafrost, by a clockwise rotation of the drilling riser. Clockwise rotation is used both to disconnect the drilling riser and to connect the production riser. To perform these operations three preferred embodiments of the invention are described: one having two threaded connections, a second having a threaded connection and a latching mechanism, and a third having a latching mechanism for both operations. All threaded connections and latching mechanisms include an axially sliding nut.

54540 Marine structure for drilling after and/or production of hydrocarbons. Mo, O. (to A/S Hoyer-Ellefsen). US Patent 4,087,984. 9 May 1978. Priority date 18 Jun 1975, United Kingdom of Great Britain and Northern Ireland (UK). 8p.

A floating offshore platform is provided which, in operation, is anchored to the sea bed by an anchoring device. The platform includes an elongate column-like structure which, in operation, floats in an upright position. An anchoring device is connected to the elongate structure by at least one vertically extending cable or the like which is tensioned to restrain vertical displacement of the structure, and a plurality of generally horizontally extending members which interconnect the lower end of the structure with the anchoring device so as to restrain lateral displacement of the lower end of the structure. With this arrangement, the column-like structure behaves as a floating column pivoted to the sea bed.

54541 Cation exchange, surfactant precipitation, and adsorption in micellar flooding. Walker, R.D. Jr. (Univ. of Florida, Gainesville); Ray, W.E.; Tham, M.K.; Lee, M.C. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 634-643(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Typical reservoir rocks are quite complex physically as well as mineralogically. The surface of sand grains available for interactions with injection fluids is a significant fraction of the total surface area, but the reactivity of sand with anionic surfactants is much less than that between clays and surfactants, so the interaction with clays tends to dominate behavior. Salting-out of alkylbenzene sulfonates from relatively dilute solutions by NaCl has been found to be substantial if the alkylchain contains more than about 12 carbons. Similarly, the multivalent cation tolerance of alkylbenzene sulfonates in dilute solutions has been found to be small and strongly dependent on equivalent weight. In general, if the equivalent weight exceeds 350 (alkyl chain more than 12 carbons), the calcium tolerance appears to be extremely small. The addition of short-chain alcohols appears to be of limited benefit. Anionic surfactants appear to adsorb on silica surfaces, which are negatively charged above a pH of about 2.0, only when significant amounts of positively charged impurities are present. Micelle adsorption on silica is not observed, probably owing to the strong coulombic repulsion between the negatively charged silica surface and the negatively charged micelles. The addition of NaCl sharply reduces the adsorption saturation level partially as a result of depression of the CMC of the surfactant at higher ionic strengths but possible also due to the influence of electrolyte of the structure of the electrical double layer at the silica/solution interface. Hemimicelle formation is observed regardless of the salt concentration. Adsorption of anionic surfactants on crushed Berea sandstone occurs on the clay only adsorption maxima are observed. The addition of one wt. % NaCl to the surfactant solution results in greatly increased adsorption but in no significant change in the shape of the adsorption isotherm.

54542 Phase behavior of a pure alkyl aryl sulfonate surfactant. Franses, E.I.; Davis, H.T.; Miller, W.G.; Scriven, L.E. (Univ. of Minnesota, Minneapolis). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 644-671(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Specctroturbidimetry, visual and microscopic observations, ultracentrifugation and ultrafiltration, conductimetry, and ^{13}C NMR were used to study the phase behavior of pure sodium 8-phenyl-n-hexadecyl-p-sulfonate in water—NaCl, decane, and water—decane. Solubility of the sulfonate in water is 0.06 wt % at 25°C and 0.7 wt % at 90°C, and it drops to 0.0002 wt % in 3 wt % NaCl (25°C). A liquid crystalline phase in equilibrium with aqueous solution contains 25 wt % water. Nucleation of supersaturated solutions is slow. Dispersability of the sulfonate is high, but NaCl has an adverse effect. 39 references, 13 figs., 5 tables. (DLC)

54543 Influence of surfactant structure on low interfacial tensions. Doe, P.H.; El-Emary, M.M.; Wade, W.H.; Schechter, R.S. (Univ. of Texas, Austin). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 672-681(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

The low interfacial tension properties of pure sulfonates are discussed in terms of the alkane carbon number for min tension (n/sub min/) and the min interfacial tension (γ/sub min/). Effects of variables on n/sub min/ and γ/sub min/ are studied. The alkylbenzene sulfonates are divided into three groups having distinct preference curves on γ/sub min/ vs n/sub min/ plots for surfactant mixtures. Surfactants with a short methyl or ethyl group ortho to the sulfonate group and a longer alkyl chain in the meta position (e.g., sulfonated 5(p-ethylphenyl)dodecane) gave very low interfacial tension ($<10^{-2}$ dyne/cm) against alkanes and crude oils. 7 figs. (DLC)

54544 Interfacial effects in the displacement of residual oil by foam. Slattery, J.C. (Northwestern Univ., Evanston, IL). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 683-694(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

The dimensionless gas-aqueous surfactant solution surface tension N/sub γ/ must be less than some critical value before any residual oil can be recovered by displacement with a foam. For displacement in a typical oil-bearing reservoir rock, this critical interfacial tension is estimated to be of the order 8×10^{-2} dyne/cm. In most foams the surface tension is considerably larger. This appears to explain why foams are frequently described as blocking agents to seal leaks in gas storage reservoirs, to prevent gas coning in the neighborhood of a production well, or to reduce the flow through high permeability zones in heterogeneous reservoirs. For values of N/sub γ/ less than the critical value, the rate of displacement of a foam can be enhanced by decreasing the surface tension and the surface viscosities. For values of N/sub γ/ less than the critical value, a foam will preferentially flow through the larger pores, failing to displace portions of the residual oil in smaller pores. The efficiency of a foam displacement can be raised by decreasing the magnitude of the pressure gradient and increasing the surface tension, which implies that the optimum value for N/sub γ/ is only slightly less than the critical value. Displacement efficiency can also be raised by increasing the viscosity of the aqueous surfactant solution and by increasing the surface viscosities. Kanda and Schechter observed that displacement efficiency was raised as the surface shear viscosity increased. The effect of the surface viscosities upon foam displacement gives added support to the predictions on the effects of the interfacial viscosities in the recovery of residual oil by surfactant waterflooding.

54545 Experimental thermochemistry of oil-recovery micellar systems. Berg, R.L.; Noll, L.A.; Good, W.D. (Bartlesville Energy Research Center, OK). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 696-703(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Enthalpies of dilution and adsorption were measured for three compounds: sodium dodecyl sulfate, sodium decyl sulfonate, and sodium dodecyl sulfonate. From the dilution enthalpy changes, critical micelle concentrations were determined and micellization enthalpies calculated. 4 tables, 8 figs. (DLC)

54546 Observations on emulsion stability and interfacial properties in improved oil recovery by chemical flooding. Wasan, D.T.; Shah, S.M.; Chan, M.; Sampath, K.; Shah, R. (Illinois Inst. of Tech.,

Chicago). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* 23: No. 2, 705-727(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Mechanisms of spontaneous emulsification in petroleum sulfonate and caustic systems are described. Differences in behavior in surfactant and alkaline solutions were characterized by high speed cinephotomicrography. Results on the kinetics of coalescence of both the Long Beach and the Huntington Beach crude oil droplets in caustic systems are presented. The effects of interfacial tension, interfacial charge and interfacial viscosity on coalescence, and emulsion stability for crude oil emulsions in alkaline solutions have been assessed. It is concluded that for equilibrated systems there is no correlation between the interfacial tension or interfacial charge and emulsion stability. However, a direct qualitative correlation was found between the interfacial viscosity and the emulsion stability. It was observed that the NaOH concentration which yields higher interfacial shear viscosity also yields higher emulsion stability. Further data on the effect of interfacial viscosity on emulsion stability and its subsequent effect on oil recovery efficiency by alkaline waterflooding are needed. The maximum electrophoretic mobility or zeta potential corresponds to the minimum interfacial tension for the caustic systems containing 1% NaCl but this correlation is not valid for systems which do not contain NaCl. The interfacial tension between the crude oil and the alkaline solution is a strong function of the age of the interface. The interfacial tension increases with the age of the interface. The interference phase contrast technique combined with high resolution optical sectioning may be extended to measure the thickness of the film surrounding oil droplets in caustic systems. The film thickness and the molecular packing in the film need to be correlated with the stability of an emulsion system. Micellar aggregates with relatively large diameters were found for both the petroleum sulfonate and the caustic flooding systems. 36 references, 17 figs., 2 tables.

54547 Borehole drilling with lime-bituminous solution flushing. Postash, S.A.; Sheikin, F.I.; Dzugkoev, T.D.; Gorodetskii, V.E.; Butin, A.I.; Gantimirov, B.M. *Neft. Khoz.;* No. 3, 9-12(Mar 1977). (In Russian).

An analysis of industrial borehole drilling tests in the Volgograd region indicates that a switchover to flushing with lime-bituminous solutions is accompanied by a sharp decrease in the number of complications, but also by a decrease in the mechanical speed of drilling hard and medium hard rocks. An examination is made of several ways of increasing mechanical speed during lime-bituminous solution washes. 3 tables, 7 references.

54548 Determination of productivity coefficients by bed testing data. Lapshin, P.S.; Strizhnev, V.A. *Neft. Khoz.;* No. 3, 17-19(Mar 1977). (In Russian).

An analysis was made of six methods of determining the productivity coefficient by bed-testing machinery data whose accuracy was compared to calculation of the spin-effect influence. Two methods are recommended for accurate computation and for proximate computations under field conditions. 1 table, 5 references.

54549 Distribution of residual petroleum reserves in productive strata of the Tuimazinskii Field. Abyzbaev, I.I.; Enikeev, V.R.; Kozlov, Yu.A.; Lebedeva, M.V.; Gazizov, E.S.; Kobeleva, V.A. *Neft. Khoz.;* No. 3, 26-29(Mar 1977). (In Russian).

Limits are established for oil saturation at which petroleum flow is possible. Results are cited for the operation of appraisable wells, and the advisability of drilling those wells at a late stage of exploitation is evaluated.

54550 Determination of current petroleum saturation of beds D/sub I/ and D/sub II/ of the Tuimazinskii Field according to the testing of appraisable wells. Shevkunov, E.N.; Permyakov, I.G.; Tokarev, M.A.; Khalikov, E.M. *Neft. Khoz.;* No. 3, 29-31(Mar 1977). (In Russian).

Methodology and results are presented for determining the current oil saturation of productive beds according to data from various methods of testing appraisable wells. Current petroleum saturation can be more precisely estimated at the late stage of exploitation by using the method prolonged testing of an appraisable well. 1 table, 6 references.

54551 Method of separating the recovery of fluid and injection of water in a multi-bed site. Maslyantsev, Yu.V.; Kashchavtsev, V.E. *Neft. Khoz.;* No. 3, 31-33(Mar 1977). (In Russian).

A method is proposed for separating fluid recovery and water injection in the joint operation of oil beds by generalized statistical characteristics. The results of separating fluid recovery and injection, as obtained by the proposed method in the Yakushkinskii field, are compared to data on hydrodynamic tests and electro-simulation. 1 table.

54552 Optimal velocities of water-oil contact movement in oil beds. Ogandzhanyants, V.G. *Neft. Khoz.;* No. 3, 33-36(Mar 1977). (In Russian).

The optimal velocity of water-oil contact movement which provides the greatest extraction of oil from linear uniform beds was experimentally established, as was the effect of the physico-chemical properties of fluids and the bed on this velocity. A relationship was obtained between the optimal velocity of water-oil contact movement and the ratio of oil and water viscosities. Anhydrous oil yield was shown to be essentially independent of the oil and water viscosities ratio when the water-oil contact advance movement is at the optimal speed. 6 references.

54553 Use of micellar solutions for treating the face zone of a bed. Gorbanets, V.K. *Neft. Khoz.;* No. 3, 37-38(Mar 1977). (In Russian).

The possibility of removing water and heavy petroleum components from the face zone with the aid of micellar solutions is demonstrated. A recommendation is given for using micellar solutions for increasing the filtration characteristics of the face zone. 2 references.

54554 Interaction of hydrolyzed polyacrylonitrile and electrolites in the sealing of flooded beds. Yusupov, I.G.; Kadyrov, R.R. *Neft. Khoz.;* No. 3, 38-40(Mar 1977). (In Russian).

Results are described for studies of the water-sealing properties of hypane gel, produced by precipitation by solutions of $CaCl_2$, $FeCl_3$ and $CuSO_4$. Recommendations are given for using electrolytes in the sealing of breakthroughs of stratal and injected water. 1 table, 5 references.

54555 Study of hydrogen sulfide distribution on drilling machinery. Khasaev, R.M.; Abdullaev, R.M.; Abbasov, A.T.; Antipov, A.N.; Alieva, E.T. *Neft. Khoz.;* No. 3, 48-52(Mar 1977). (In Russian).

An empirical formula is devised for determining the concentration of hydrogen sulfide in any point of a borehole's operating area under windless conditions in relationship to initial concentrations and distances from the borehole's mouth. Measures are proposed for the construction of boreholes, control of atmospheric hydrogen sulfide content, and technical and engineering safety measures for borehole drilling. 2 tables, 3 references.

54556 Improving methods for making froth-forming solutions. Makhmutov, N.R.; Vel'boy, A.N. *Neft. Khoz.;* No. 3, 55-56(Mar 1977). (In Russian).

The effectiveness of injecting foam into productive oil well beds for limiting flow influx was shown to depend on the method of making the froth-forming fluid. A description is given of a special dissolving unit for making foam-forming fluid used by the Chekmagush Petroleum Production Association.

PROCESSING

54557 Isolation of native petroleum fractions for lowering interfacial tensions in aqueous-alkaline system. Farmanian, P.A. (Univ. of Southern California, Los Angeles); Davis, N.; Kwan, J.T.; Yen, T.F.; Weinbrandt, R.M. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* 23: No. 2, 728-734(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Petroleum samples from production wells in the Huntington Beach Field were fractionated and the interfacial tension properties of each fraction studied. One fraction, whose dark color indicates asphaltic material, has a wide pH range (60 to 60,000 ppM alkalinity) for ultralow tension. Its aging behavior shows spontaneous emulsification and coalescence. 4 figs. (DLC)

54558 Nature of vanadium complexes in the refining of heavy oil. Yen, T.F. (Univ. of Southern California, Los Angeles). *Energy Sources;* 3: No. 3/4, 339-351(1978).

Vanadium complexes in native petroleum are discussed with regard to their origins and diagenesis. The basic structural information of vanadium in heavy, dark, residual asphaltic oil is reassessed when the geobiological aspects of the complexes are revealed. Application of the structural concept of vanadium complexes is given to explain the hydrodesulfurization catalysis.

54559 Method for separating wax from petroleum and measures for operation. Borst, H.; Evans, R.D.O.; Rand, J.A. (to Unilever N.V.). German(FRG) Patent 2,651,784/A/. 2 Jun 1977. 22p. (In German).

To separate wax or paraffines from mineral oil, a mixture of ploymerized polyol esters is added to the mineral oil, and the solution is cooled down whereby the paraffine and at least part of the ester crystalline out. Normally, the amount of polyol esters added is about 1% of the paraffine content of the mineral oil. The polyol preferably used in the production of the polyol esters are

polyglycerines with 8 to 14 glycerin residues. The chain lengths of the fatty acids used is chosen in such a way that the polymerized polyol esters crystallize out of the paraffine solution at practically the same temperature as the paraffine. Preferably, the ratio of exterified C_{20}- to C_{34}-fatty acids to esterified C_8- to C_{18}-fatty acids should be 20:80 to 80:20.

54560 Method for cooling a crude gas mixture with differently boiling hydrocarbons. Frank, H.; Langebach, H.P. (to Linde A.G.). German(FRG) Patent 2,538,611/A/. 3 Mar 1977. 11p. (In German).

The crude gas mixture is cooled down in two stages, first by direct evaporation of water and in the second stage by the supply of outside cold. Hydrocarbons and solid impurities from the crude gas mixture which may form deposits on heat exchanger surfaces are washed out (or condensed out) as early as in the first stage. This mixture is separated into a fraction enriched in hydrocarbons and impurities and another, water-rich fraction, and the water-rich fraction is led back into the first stage together with part of the water/hydrocarbon fraction produced in the second cooling stage.

54561 Method for separating solid fines from liquid hydrocarbons. Chachere, J.D. (to Gulf Research and Development Co.). German(FRG) Patent 2,631,274/A/. 17 Feb 1977. 17p. (In German).

Fine-grained solids from hot liquid hydrocarbon fractions are separated in an electrofilter or in several electrofilters connected in series. The filter beds consist of mainly spherical particles made of a material with a high electrical resistance, e.g. glass, and a voltage gradient of 2 to 8 KV/cm is applied to the filter bed. The solid material is removed from the discharged filter by washing with the returned filtered product or with another electrically non-conductive liquid. The returned washing liquid from the filter is added to the initial material of a fluidized-bed process, e.g. a catalytic fluidized-bed separation process or a fluidized-bed coking process.

54562 Method of reforming hydrocarbons. Okagami, A.; Horie, A.; Toida, T. (to Japan Gasoline Co., Ltd.). US Patent 3,932,147. 13 Jan 1976. vp.

Japan Gasoline Co., Ltd.'s new gasification approach avoids the need for an excess of steam to maintain catalyst activity when gasifying hydrocarbon feeds of different kinds (such as naphtha, kerosene, LP-gas, etc.) within one combined reaction system. The method introduces a mixture of hydrocarbons into the reaction zones of two or more catalyst beds distributively while introducing the whole amount of the steam into the reaction column of the first stage, thus augmenting the ratio of the steam to the mixture of hydrocarbons within the respective reaction zones. A mixture consisting of steam and hydrocarbons whose mean molecular weight is relatively small is introduced to the nickel-containing catalyst bed for the first stage at a temperature range of 662°—1022°F (350°—550°C). The resulting product is mixed with hydrocarbons whose mean molecular weight is larger than that of the preceding hydrocarbon--along with steam, if necessary--and is introduced to the nickel-containing catalyst bed at a temperature in the range of 572°—1022°F (300°—550°C) for the second stage.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 54769, 54778, 55294

HEALTH AND SAFETY

54563 (BETC/TPR—78/5) **Diesel odor measurement: comparison of two methods.** Marshall, W.F.; Seizinger, D.E. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Aug 1978. 9p. Dep. NTIS, PC A02/MF A01.

The Department of Energy's Bartlesville (Okla.) Energy Technology Center (BETC) continues to investigate the influence of exhaust-treatment devices on emissions from diesel engines used in underground mining applications, studying the effects of such devices on exhaust odor levels. Two methods of odor evaluation are used routinely—a human odor panel and the Arthur D. Little Diesel Odor Analysis System. Results obtained in a study involving two engines and four catalytic reactors show that the oxidation catalysts decreased exhaust-odor intensity as measured by both methods. However, there was poor statistical correlation between intensity values measured by the two techniques. Although directionally similar results were obtained by the two techniques, absolute values of odor intensity for one method cannot be reasonably well estimated from measurements via the other method.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 54506, 54507, 55293, 55295

54564 (NP—23204) **International energy trends: monthly supplement on oil trends.** (Organization for Economic Co-Operation and Development, 75 - Paris (France)). 17 Mar 1978. 32p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Data are presented in graphs and tables on consumption of oil products, net oil and crude imports, stock levels of all oil, production of crude oil, oil import prices and index of industrial production. The data refer to the U.S., European countries, Japan, other OECD countries, and OPEC. (JRD)

54565 Oil from the UK Continental Shelf. London; U.K. Dept. of Energy (1976). 11p.

This fact sheet describes progress in the development of oil from the UK sector of the Continental Shelf. Some of the areas covered include: development; production; legislative framework; finance; and the anticipated impact on the UK's economy.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 54575

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 55866, 55868, 55869, 55920

54566 (NP—23307) **Oil spills and spills of hazzrdous substances.** Biglane, K.E. (Environmental Protection Agency, Washington, DC (USA). Div. of Oil and Special Materials Control). Mar 1977. 44p. GPO.

Significant spill incidents are described and methods of response to spills are reviewed. Information is included on effects of spills, prevention of spills, responding to spills, spill surveillance, international cooperation, and EPA regional offices. (JRD)

54567 (NP—23308) **Final environmental impact statement: proposed 1977 OCS oil and gas lease sale. Volume 1 of 2.** (Bureau of Land Management, Washington, DC (USA)). Jan 1977. 445p. U.S. Dept. of the Interior, Bureau of Land Management, Washington, DC.

The statement is related to the proposed lease sale of two hundred thirty-three tracts 450,355 ha (1,112,827 acres) of outer continental shelf land. The tracts are located offshore Texas, Louisiana, Mississippi, and Alabama. All tracts offered pose some degree of pollution risk to the environment. The risk potential is related to adverse effects on the environment and other resource uses which may result principally from accidental or chronic oil spillage. Each tract offered is subjected to a matrix analyses technique in order to evaluate significant environmental impacts should leasing and subsequent oil and gas exploration and production ensue. A detailed description of the proposal is presented along with sections concerning the environment, environmental impacts, mitigating measures, alternatives, and coordination with others. (JRD)

54568 (PB—277669) **Modeling methods for predicting oil spill movement.** Rath, R.J.; Francis, B.H. (Oceanographic Inst. of Washington, Seattle (USA)). Mar 1977. 106p. (OIW/OCW—7502). NTIS PC A06/MF A01.

The study consists of a literature search and an evaluation of 17 representative papers on modeling the surface movement of spilled oil in the marine environment. The modeling approaches vary considerably in complexity and are based on experiments, observations, and theoretical considerations, or combinations thereof. In addition to the evaluation of the individual models, the study contains an overview of the state-of-the-art of predicting oil spill movement by utilizing oil spreading and drift models. The overview includes a discussion of controversial parameters, methods of model verification, and studies which are being conducted to extend the methodology to three dimensions by considering the distribution of spilled oil in the atmosphere, the water column, and bottom sediments.

54569 Subsidence as a result of petroleum production. Ertekin, T. *Earth Miner. Sci.;* **47**: No. 8, 57,60-62(May 1978).

Subsidence in oil-producing areas is caused by the compaction of the producing layers of the underground reservoirs. Decline in the fluid pressure in the pores of the reservoir rock forces the formation to carry a larger portion of the overburden load. When the formation material fails to carry this load, compaction takes place and subsidence results at the surface. Compaction causes significant subsidence, especially when the formation material consists of clay and uncemented sand. Clay and sand layers compact almost to the same extent, the main difference being that the low permeability of the clay to water prevents instantaneous compaction and the time effect becomes an important factor. Additional factors

that contribute to an appreciable delay in the subsidence noticed at the surface include creep, both in clay and sand, decrease in reservoir fluid pressure, and overburden which does not deform elastically.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 55292, 55296

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 54491

54570 (AD-A—050571) **Can pyrophoric materials form in oil tankers with inert gas fire protection systems. Final report.** Affens, W.A. (Naval Research Lab., Washington, DC (USA)). Dec 1977. 14p. (NRL-MR—3678). NTIS PC A02/MF A01.

A literature study and analysis was made concerning the potential hazard of pyrophoric ignition of flammable vapors in oil tankers with inert gas systems (IGS). Only two pyrophor possibilities seem to be likely: Formation of ferrous sulfide (FeS) and/or ferrous oxide (FeO). Both FeS and FeO may be formed in an oxygen limited atmosphere, such as would be the case with a flue gas IGS. Formation of FeS also requires an atmosphere containing hydrogen sulfide (H_2S), as would be the condition with 'sour' crudes, so that the hazard of the formation of pyrophoric FeS must be considered for such crudes. Furthermore, if sea water is present in the oil tank, oils which do not contain H2S can become 'sour' by the action of sulfate reducing bacteria on sulfates in the water. It is concluded that in the event of failure of an IGS system, the ullage space should not be exposed to air suddenly. (Author)

54571 (EMD—78-52) **Lessons learned from constructing the Trans-Alaska Oil Pipeline.** (General Accounting Office, Washington, DC (USA)). 15 Jun 1978. 65p. General Accounting Office, Washington, DC.

It is noted that construction of the trans-Alaska oil pipeline turned out to be a costly experience. This experience should be applied to future large-scale Arctic construction projects (such as the Alaska natural gas pipeline) in the hope of keeping costs under control. It is recommended that for future similar projects, first and subsequent cost estimates should be viewed with skepticism; as much site-specific data as is economically practicable should be obtained; technical and geological uncertainties should be thoroughly investigated; government approval should be contingent on detailed planning for management control, including budgetary controls; and the Alaska natural gas pipeline project's expenditures should have an ongoing Government audit to protect the public interest. In 1968 a feasibility cost study estimated that an oil pipeline system from Prudhoe Bay to Valdez, Alaska, would cost $863 million for a 500,000-barrel-a-day line or $1.046 billion for a 1.2-million-barrel-a-day capacity. These estimates, based on minimal site-specific data, contained no allowances for cost escalation. The final cost estimate was $7.9 billion. Evaluations are included of project management, labor negotiations, and Government actions. (JRD)

54572 **Starting conditions of a pipeline with congealed petroleum.** Didenko, V.S.; Degtyarev, V.N. *Neft. Khoz.;* No. 3, 44-47(Mar 1977). (In Russian).

A method is given for determining the minimal initial shear stress of congealed petroleum for calculating starting pressure. A formula is proposed for determining the time for resuming pumping along a pipeline filled with viscous plastic petroleum. 3 references.

PROPERTIES

REFER ALSO TO CITATION(S) 54557, 55532

54573 (BETC/PPS—78/3) **Motor gasolines, winter 1977—78.** Shelton, E.M. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Jul 1978. 80p. Dep. NTIS, PC A05/MF A01.

Analytical data for 2,738 samples of motor gasoline, from service stations throughout the country, were collected and analyzed under agreement between the Bartlesville Energy Technology Center and the American Petroleum Institute. The samples represent the products of 52 companies, large and small, which manufacture and supply gasoline. These data are tabulated by groups according to brands (unlabeled) and grades for 17 marketing areas and districts into which the country is divided. A map, included in this report, shows marketing areas, districts and sampling locations. The report also includes charts indicating the trends of selected properties of motor fuels since 1946. Twelve octane distribution percent charts for areas 1, 2, 3, and 4 for unleaded, regular, and premium grades of gasoline are presented in this report. The antiknock (octane) index [(R + M)/2] averages of gasolines sold in this country were 88.4, 89.5, and 94.9 for unleaded, regular, and premium grades of gasolines, respectively.

54574 (BETC/RI—78/16) **National motor gasoline surveys: a key source of fuel trend data.** Coleman, H.J.; Shelton, E.M.; Thompson, C.J. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Aug 1978. 18p. Dep. NTIS, PC A02/MF A01.

The quality of motor gasolines marketed throughout the United States is of both theoretical and practical interest to chemists and engineers throughout industry, government, and universities. The National Motor Gasoline Surveys Project, a cooperative project of the Bartlesville (Oklahoma) Energy Technology Center (BETC) and the American Petroleum Institute (API), is a periodic survey of the characteristics, properties, and quality of both winter and summer motor gasolines as obtained on samplings from all 17 major marketing districts of the United States. The semi-annual publications by the Department of Energy at BETC not only present data and fuel trends useful for fuel and engine improvements and development of meaningful fuel specifications, but also constitute a citable source of information for researchers. The reporting of motor gasoline quality provides some bases for extrapolating to the desired and/or required octane number rating of fuels in the 1980's.

54575 **Determination of petroleum in waste water in presence of solvents.** Geyer, D.; Martin, P. (Stadt Muenchen (Germany, F.R.). Abt. Stadtentwaesserung); Adrian, P. (Beckman Instruments G.m.b.H., Muenchen (Germany, F.R.)). *Gas- Wasserfach, Wasser - Abwasser;* **119**: No. 2, 72-74(Feb 1978). (In German).

Mixtures of different solvents with mineral oil were investigated by IR spectroscopy. Toluene and oil can only be quantitatively determined, qualitatively they are very hard to differentiate. Trichloroethylene and oil can be determined together quantitatively. Methylene chloride and oil can be qualitatively identified but not quantitatively determined.

54576 **Standard test method for apparent viscosity of hot melt adhesives and coating materials.** *Annu. Book ASTM Stand.;* No. 25, 97-106(1977).

ANSI/ASTM-D—3236-73.

Determination of apparent viscosities of hot melt adhesives and coating materials having apparent viscosities of up to 200,000 mPa's at temperatures up to 175°C is described. A sample of the molten material is maintained in a thermally controlled sample chamber, and the apparent viscosity is determined under temperature equilibrium conditions using a precision rotating spindle type viscometer. A description of the equipment and tables of spindle factor data are included in the appendix to the method.

54577 **Standard test method for lead in gasoline by atomic absorption spectrometry.** *Annu. Book ASTM Stand.;* No. 25, 107-108(1977).

ANSI/ASTM-D—3237-74.

Determination of total lead in gasoline within the concentration range of 0.010 to 0.10 g of lead/U.S. gal (2.5 to 25 mg/l) by atomic absorption spectrometry at 2833 A is described. The sample to be analyzed is diluted with methyl isobutyl ketone, and the alkyl lead compounds are stabilized by reaction with iodine and a quaternary ammonium salt. The lead in the sample is determined from a comparison of the value measured at 2833 A for the sample and that value measured for reagent grade lead chloride standards. The determination is independent of lead alkyl type compounds.

54578 **Standard test method for calculation of carbon distribution and structural group analysis of petroleum oils by the n-d-M method.** *Annu. Book ASTM Stand.;* No. 25, 109-110(1977).

ANSI/ASTM-D—3238-74.

Measurements of refractive index, density, and molecular weight can be used to calculate the carbon distribution and ring content of olefin-free petroleum oils. Equations are included in this method for calculation of the desired quantities using measurements of the physical properties. The method is not applicable to oils having greater than 75% of the carbon atoms in ring structure with the percentage in aromatic rings not being larger than 1.5 times the percentage in naphthenic rings and having no more than 4 rings per molecule with not more than half of the rings being aromatic.

54579 **Standard method for aromatic types analysis of gas-oil aromatic fractions by high ionizing voltage mass spectrometry.** *Annu. Book ASTM Stand.;* No. 25, 111-130(1977).

ANSI/ASTM-D—3239-76.

A mass spectrometric method using a summation of peaks most characteristic of a given class of compounds is described for the analysis of 18 hydrocarbon types and 3 aromatic thiophenotypes

in straight run aromatic petroleum fractions boiling within the temperature range of 400 to 1000°F. Calculations of volume % of different classes are carried out by the use of a 7 by 7 inverted matrix derived from published spectra of pure aromatic compounds. The method is applicable to nonolefinic samples containing not more than 1 wt % of total S and not more than 5% nonaromatic hydrocarbons.

54580 Standard test method for undissolved water in aviation turbine fuels. *Annu. Book ASTM Stand.;* No. 25, 131-133(1977).
ANSI/ASTM-D—3240-75.

A method is described for the determination of undissolved water in aviation fuels by passing the fuel through a uranine dye-treated filter pad, and then exposing the pad to ultraviolet light. The dye previously contacted by water will fluoresce a bright yellow, and the brightness is directly related to the amount of free water in the fuel. Comparison of the uv-light-illuminated pad with a known standard using a photocell comparator yields a direct reading of the water content of the sample in ppM. The method is applicable to flowing streams of fuel without exposing the fuel to the atmosphere and without the need for a sample container.

54581 Standard test method for thermal oxidation stability of aviation turbine fuels (JFTOT procedure). *Annu. Book ASTM Stand.;* No. 25, 134-156(1977).
ANSI/ASTM-D—3241-77.

The high temperature stability of gas turbine fuels can be determined using the Jet Fuel Thermal Oxidation Tester which is described in detail in the appendix to the method. The fuel is pumped at a fixed rate through a heater and then through a precision stainless steel filter where fuel degradation products may become trapped. A sample volume of 600 ml is required for a $2^1/_2$-hr test.

54582 Standard test method for total acidity in aviation turbine fuel. *Annu. Book ASTM Stand.;* No. 25, 157-160(1977).
ANSI/ASTM-D—3242-74.

A method is described for the determination of the total acidity in aviation turbine fuels in the range from 0.000 to 0.100 mg KOH/g. The acid is titrated standard alcoholic KOH to the end point indicated by the color change of a p-naphtholbenzein solution added to the sample after it is dissolved in a mixture of toluene and isopropyl alcohol containing a small amount of water. The sample is blanketed with nitrogen during the titration.

54583 Standard practice for utilization of test data to determine conformance with specifications. *Annu. Book ASTM Stand.;* No. 25, 170-179(1977).
ANSI/ASTM-D—3244-77.

A standard practice is described for the comparison of measurements of properties of petroleum products. A technique is described for comparing an assigned test value with a specification limit to indicate when test results obtained by two laboratories differ significantly. Statistical criteria are set forth to give a basis for acceptance or rejection of a product on the basis of test results.

54584 Standard test method for pumpability of industrial fuel oils. *Annu. Book ASTM Stand.;* No. 25, 180-184(1977).
ANSI/ASTM-D—3245-76.

The determination of the minimum cold storage and minimum handling temperatures which may be used for a given fuel oil is described. The sample of oil (preheated if necessary to render it liquid) is poured into the cup of a Ferranti portable viscometer. The cup is then immersed in a bath at 82°C for 20 min and then transferred to a bath at a predetermined temperature. After a brief period of time to insure equilibrium temperature of the sample, the viscometer is started, and the bath is cooled at a rate of 0.5°C/min. The temperature at which viscosities of 6 P and 25 P are obtained are determined. The temperature at which the viscosity of 6 P is noted is designated as the handling point and that corresponding to 25 P as the storage point.

54585 Standard test method for sulfur in petroleum gas by oxidative microcoulometry. *Annu. Book ASTM Stand.;* No. 25, 185-191(1977).
ANSI/ASTM-D—3246-76.

The microcoulometric method is applicable to the determination of S in the range of 1.5 to 100 ppM in hydrocarbon products that are gases at normal temperature and pressures. The method is applicable to the determination of volatile S in liquid samples; however, another method must be used for total S on such samples. Oxidative pyrolysis converts the S to SO_2 which then flows to a titration cell where it reacts with triiodide ion. The total current necessary to coulometrically replace the consumed triiodide ion is a measure of the sulfur present in the sample. Halide concentrations of up to 10 times the S level and total N_2 concentrations of up to 1.0% do not interfere with the method; however, the method is not applicable in the presence of total heavy metal concentrations in excess of 500 ppM.

54586 Standard test method for performance characteristics of lubricating greases in ball bearings and elevated temperatures. *Annu. Book ASTM Stand.;* No. 25, 192-199(1977).
Designation: D—3336-75.

A method is described for evaluating the ability of a grease to provide adequate lubrication for extended periods of ball bearings operating under light loads at high speeds and elevated temperatures. The apparatus and procedure are described in detail. Test apparatuses with various loads are presented diagrammatically in the appendix as are graphs showing the test results for failure times for certain standard greases.

54587 Standard method for evaluation of greases in small bearings. *Annu. Book ASTM Stand.;* No. 25, 200-211(1977).
ANSI/ASTM-D—3337-74.

The method described is intended for laboratory and not for field use to determine the grease life and torque in small bearings at high temperatures. Specifications for the test bearing are stated, and the procedure for testing the grease in the bearing is detailed. Schematic diagrams of the test apparatus are included.

54588 Standard method for estimation of heat of combustion of aviation fuels. *Annu. Book ASTM Stand.;* No. 25, 212-216(1977).
ANSI/ASTM-D—3338-74.

An empirical method for estimating the heat of combustion of aviation fuels is based on a correlation between the net heat of combustion and gravity, aromatic content, and average volatility of the fuel. Equations are given for the correlation of these measurements.

54589 Standard test method for total acid number of petroleum products by semi-micro color indicator titration. *Annu. Book ASTM Stand.;* No. 25, 217-222(1977).
ANSI-ASTM-D—3339-74.

A method is described for the determination of acids in new and used petroleum products and lubricants soluble or nearly soluble in mixtures of toluene and isopropyl alcohol. The single phase solution resulting from dissolving the oil in the mixed solvents is titrated at room temperature under a nitrogen atmosphere with standardized 0.01 N potassium hydroxide to the stable green color of the p-naphtholbenzein indicator. The method is applicable to the determination of acids having dissociation constants in water larger than 10^{-9}. Weak acids with dissociation constants smaller than 10^{-9} do not interfere, but salts will interfere if their hydrolysis constants are larger than 10^{-9}.

54590 Standard test method for lithium and sodium in lubricating greases by flame photometer. *Annu. Book ASTM Stand.;* No. 25, 223-225(1977).
ANSI/ASTM-D—3340-74.

Lithium and sodium can be determined in lubricating grease by a flame photometric method by extracting with water the ash resulting from ignition of the grease. The procedure, calculating of results, and reporting of results are described in detail.

54591 Standard test method for lead in gasoline—iodine monochloride method. *Annu. Book ASTM Stand.;* No. 25, 226-229(1977).
ANSI/ASTM-D—3341-74.

Total lead determination in gasolines containing between 0.12 and 6.0 g Pb/UK gal, 0.1 and 5.0 g Pb/US gal, and 0.026 and 1.3 g Pb/l lead alkyls is described. Tetraalkyl lead compounds are reacted with aqueous iodine monochloride reagent and are extracted into the aqueous phase as the dialkyl lead compounds. The organic material in the extract is removed by oxidation with nitric acid, and the residue is dissolved in distilled water, buffered to pH 5 using sodium acetate-acetic acid buffer and titrated with EDTA using xylenol orange as an indicator.

54592 Standard test method for emulsion stability of new (unused) rolling oil dispersions in water. *Annu. Book ASTM Stand.;* No. 25, 230-234(1977).
ANSI/ASTM-D—3342-74.

In order to determine the emulsion stability of dispersions of rolling oils in water, the rolling oil is dispersed in a standard test water in a standard container under standard conditions. After agitation, the resulting decrease in oil concentration at a specific point near the bottom of the container is measured at certain time intervals and plotted. The method is applicable to oils whose water dispersions are stable under moderate agitation, but which show at least some separation upon standing quiescent for $^1/_2$ h.

54593 Standard method for estimation of hydrogen content of aviation fuels. *Annu. Book ASTM Stand.;* No. 25, 235-239(1977).
ANSI/ASTM-D—3343-74.

An empirical method is described for estimation of the hydrogen content (weight %) of aviation gasolines and aircraft turbine and jet engine fuels. Equations are given that correlate the hydrogen content of a fuel and its distillation range, API gravity, and aromatic content.

54594 Standard test method for total wax loading of corrugated paperboard. *Annu. Book ASTM Stand.;* No. 25, 240-242(1977).

ANSI/ASTM-D—3344-74.

The total quantity of wax present in a specimen of wax-treated corrugated paperboard can be determined by extracting the wax from the board and evaporating the solution to dryness. The method is applicable to specimens that have been waxed by either saturation operations or coating operations, or combinations of these operations.

54595 Rapid field test for trace lead in unleaded gasoline (colorimetric method). *Annu. Book ASTM Stand.;* No. 25, 243-248(1977).

ANSI/ASTM-D—3348-74.

A field test method is described for the determination of small amounts of lead in unleaded gasoline. The sample of gasoline is treated with iodine and tetraethyl ammonium chloride in chloroform and subjected to ultraviolet light. The lead alkyls are removed from the gasoline by extraction with an aqueous ammonium nitrate solution. After extraction, the aqueous phase is filtered into a solution of 4-(2-pyridylazo)-resorcinol disodium salt (PAR) and ammonium hydroxide. The lead-PAR complex is measured colorimetrically at 490 nm, and the lead is determined from a previously established calibration curve. The method is applicable to the measurement of lead in the range from 0.01 to 0.10 g Pb/U.S. gal (2.64 to 26.4 mg Pb/l).

54596 Standard test method for gas bubble separation time of petroleum oils. *Annu. Book ASTM Stand.;* No. 25, 249-252(1977).

ANSI/ASTM-D—3427-75.

In order to determine the ability of a petroleum-type steam turbine oil to separate entrained gas, compressed gas is blown through the test oil which has been heated to 25, 50, or 75°C. After the gas flow is stopped, the time required for the gas entrained in the oil to reduce in volume to 0.2% is recorded as the gas bubble separation time. The preparation of the apparatus and the complete procedure are described.

54597 Standard test method for torque stability wear and brine sensitivity evaluation of ball joint greases. *Annu. Book ASTM Stand.;* No. 25, 253-267(1977).

ANSI/ASTM-D—3248-75.

Two procedures, the torque stability test and the brine sensitivity test, are described for evaluating the stability of greases for use in automobile chassis ball joints. The lubricated joint stud and bearing, confined in a fixed housing, is rocked through an arc under prescribed conditions of rocking frequency, rocking amplitude, load, and time. The noise, wear, and torque are observed and recorded. Both the torque stability test, which provides a measure of the frictional and antiwear properties of grease when subjected to load and prolonged working under oscillating motions, and the brine sensitivity test, which measures the ability of a grease to prevent noise from an oscillating ball joint when that joint is exposed to brine, are intended as screening aids in selection of greases. The apparatus and procedure for both the tests are described in detail. The apparatus is depicted both pictorally and schematically.

54598 Standard test method for trace nitrogen in liquid petroleum hydrocarbons (microcoulometric method). *Annu. Book ASTM Stand.;* No. 25, 276-286(1977).

ANSI/ASTM-D—3431-75.

A microcoulometric method for the determination of total trace nitrogen in liquid hydrocarbons boiling in the range from 50 to 550°C is described. Reductive pyrolysis converts the nitrogen to ammonia which then reacts with hydrogen in a titration cell. The hydrogen ions consumed are replaced coulometrically, and the required replacement current is a measure of the nitrogen present in the sample. The method is applicable to naphthas, distillates, and oils containing 2 to 5000 ppM total nitrogen.

54599 Standard test method for surface wax coating on corrugated board. *Annu. Book ASTM Stand.;* No. 25, 298-300(1977).

ANSI/ASTM-D—3521-76.

The surface wax coating on corrugated board was determined by delaminating the coated facing to obtain a ripple-free sheet, then scraping off the wax using a razor blade, and calculating the wax removed. The method is applicable to a board to which wax has been applied by curtain coating, roll coating, or other methods.

54600 Standard test method for applied coating wax and impregnating (saturating) wax in corrugated board facing. *Annu. Book ASTM Stand.;* No. 25, 301-303(1977).

ANSI/ASTM-D—3522-76.

A method is described for the separate determination of the weight of wax applied to the surface of a corrugated board and the wax impregnating the same board. A specimen of the board is stripped of its coated facing, and the coated facing sample is split into two layers, one bearing the coating on the waxed fibers and the other containing only the waxed fibers of the board. The layers are extracted separately with several portions of trichloroethane at 75°C, then the extracts are combined and evaporated. The weight of the residue after evaporation of the solvent and any accompanying water is a measure of the wax in the original sample.

54601 Standard test method for diesel fuel diluent in used diesel engine oils by gas chromatography. *Annu. Book ASTM Stand.;* No. 25, 308-312(1977).

ANSI/ASTM-D—3524-76.

As a means of evaluating the possible performance problems of diesel engines, the diesel fuel in lubricating oil is determined. The method is limited to SAE 30 oil. n-Decane is used as a solvent for the sample for chromatographic analysis. The procedure is described with typical column operating conditions being given.

54602 Standard test method for gasoline diluent in used gasoline engine oils by gas chromatography. *Annu. Book ASTM Stand.;* No. 25, 313-316(1977).

ANSI/ASTM-D—3525-76.

A gas chromatographic method is described for the determination of the amount of gasoline in engine oils used in gasoline engines. n-Tetradecane is used as an internal standard, and the final detection must be carried out with a dual-flame ionization detector.

54603 Standard test method for life performance of automotive wheel bearing grease. *Annu. Book ASTM Stand.;* No. 25, 317-327(1977).

ANSI/ASTM-D—3527-76.

An apparatus and procedure are described for evaluating the high-temperature life performance of wheel bearing grease. The grease is distributed in the apparatus that consists of a special front wheel hub-spindle-bearings assembly encased in an electrically heated, thermostatically controlled oven. The hub is rotated at 1000 rpm, and the spindle temperature is maintained at 150°C on a 20-h on and a 4-h off operation cycle. When grease deterioration causes the drive motor torque to increase to four times the steady state torque, the test is terminated.

54604 Standard field test method for water separation characteristics of aviation turbine fuels. *Annu. Book ASTM Stand.;* No. 25, 332-342(1977).

ANSI/ASTM-D—3602-77.

In order to measure the water separation characteristics of aviation fuel, the fuel is emulsified with water in a syringe using an ultrasonic probe. The emulsion is then expelled from the syringe at a prescribed rate through a standard fiberglass coalescer, and the effluent is analyzed for uncoalesced water by a light transmission measurement. A reporting scale of 0 to 100 is used with a high rating indicating that the water is easily coalesced, and, therefore, that the fuel contains low amounts of surfactant materials. The procedure is intended for use on fuel after it is blended or delivered to the point of use.

54605 Standard test method for rust-preventing characteristics of steam turbine oil in the presence of water (horizontal disk method). *Annu. Book ASTM Stand.;* No. 25, 343-354(1977).

ANSI/ASTM-D—3603-77.

A procedure is described for indicating the ability of oils to prevent rusting of horizontal and vertical ferrous surfaces when water becomes mixed with the oil. A horizontal steel disk and vertical steel cylinder are completely immersed in a stirred mixture of 275 ml of oil being tested and 25 ml of water at 60°C. The test is run for 6 h during which time the horizontal steel disk allows water to collect on the surface and the vertical specimen is continually washed with the oil-water mixture.

54606 Standard test method for trace metals in gas turbine fuels by atomic absorption and flame emission spectroscopy. *Annu. Book ASTM Stand.;* No. 25, 361-364(1977).

ANSI/ASTM-D—3605-77.

The determination of Na, Pb, Ca, and V in gas turbine fuels No. 1-GT and No. 2-GT is described. Pb is determined by atomic absorption in a premixed air-acetylene flame. Na, Ca, and V are determined by atomic absorption or atomic emission in a premixed air-acetylene flame.

54607 Standard test method for benzene and toluene in finished motor and aviation gasoline by gas chromatography. *Annu. Book ASTM Stand.;* No. 25, 365-372(1977).

ANSI/ASTM-D—3606-77.

A gas chromatographic method for the determination of up to 5 vol % of benzene and up to 20 vol % of toluene in gasolines is described. Methyl ethyl ketone is added to the gasoline as an internal standard, and the concentration of each component is calculated with reference to the internal standard.

54608 Standard method for removing volatile contaminants from used engine oils by stripping. *Annu. Book ASTM Stand.;* No. 25, 373-375(1977).

ANSI/ASTM-D—3607-77.

Volatile contaminants such as gasoline and water were removed from used engine oils by heating the oil sample to 90°C under a N_2 flow for 4.5 h. If the amount of volatile materials present is desired, the sample is weighed before and after heating to yield a measure of the volatile material.

54609 Proposed test methods for filterability of aviation turbine fuels. *Annu. Book ASTM Stand.;* No. 25, 821-824(1977).

Particulate matter can be removed from aviation turbine fuels by filtration. A known volume of fuel is filtered through a membrane filter, and the time required for filtration is an indication of the particulate contamination. This particulate contamination can be determined gravimetrically according to ASTM method D2276.

54610 Proposed test method for boiling range distribution of crude petroleum by gas chromatography. *Annu. Book ASTM Stand.;* No. 25, 825-831(1977).

A gas chromatographic method is described for determining the boiling temperature ranges of crude petroleum and high-boiling petroleum fractions. After introduction of the sample via a micro syringe onto the column, the column temperature is raised at a reproducible rate, and the area under the chromatogram is recorded. A mixture of hydrocarbons of known boiling points covering the boiling range through 1000°F is used for calibration. An internal standard is used for estimation of the amount of sample boiling above 1000°F.

54611 Proposed method for boiling range distribution of gasoline and gasoline fractions by gas chromatography. *Annu. Book ASTM Stand.;* No. 25, 832-845(1977).

A gas chromatographic method is described for determining the boiling range distribution of gasoline and gasoline components with a final boiling point of 260°C or lower. Separation conditions are selected so as to separate isopentane and lighter saturates discretely. Normal pentane and heavier components are not separated completely.

54612 Proposed test method for benzene in finished motor and aviation gasoline by infrared spectrophotometry. *Annu. Book ASTM Stand.;* No. 25, 846-848(1977).

An infrared spectrophotometric method for the determination of concentrations of benzene from 0 to 8% in motor and aviation gasolines is described. The absorbance of the sample is measured at 14.86 mμ, and the concentration of benzene is calculated from a standard calibration curve. Toluene and heavier aromatics cause some interference with the determination.

54613 Proposed catalyzed oxidation tests for lubricating oils and hydraulic fluids. *Annu. Book ASTM Stand.;* No. 25, 849-887(1977).

Four separate methods for determining the catalyzed oxidation of lubricating oils and hydraulic fluids are described. These methods all use different equipment for the same basic procedure. The test fluid is placed in a glass tube, and solid metal or soluble liquid catalyst is added. The mixture is heated in an aluminum bath with nitrogen or air bubbled through the fluid. The off gases are either trapped or returned to the test cell, depending upon the particular method. The methods are included in their entirety, and the significance of each procedure is explained. In order to somewhat standardize the methods, a list of 4 guidelines is presented.

54614 Standard test methods for flash point of aviation turbine fuels by setaflash closed tester. *Annu. Book ASTM Stand.;* No. 25, 161-169(1977).

ANSI/ASTM-D—3243-77.

A procedure is described for the determination of the flash point of aviation turbine fuels. The procedure may be used to determine whether a fuel will or will not flash at a specified temperature (flash/no flash), or the actual flash point temperature. The presence of volatile diluents may also be determined by this procedure. Results using the specified apparatus have been shown to be comparable in magnitude to those obtained by using the Tag Closed-Cup procedure as described in Method D 56. This standard should be used to measure and describe the properties of materials, products, or systems in response to heat and flame under controlled laboratory conditions and should not be used for the description or appraisal of the fire hazard of materials, products, or systems under actual fire conditions.

54615 Kachestvo nefti i nefteproduktov. (Quality of petroleum and petroleum products). Mineev, A.I.; Soshchenko, E.M. Moscow; Izdatel'stvo Nedra (1976). 78p.

Materials are presented which describe the manner in which the quality of oil and petroleum products is determined upon their shipment and receipt and the way in which standard delivery documentation is completed and approved. The conduct of arbitration cases is examined. The reference aid is designed for engineering-technical and legal (lawyers) personnel engaged in the supply of oil and petroleum products to various sectors of the national economy.

STORAGE

54616 Method of stabilizing mineral oil and its refinery products. Nottes, G.; Bronstert, K.; Klaerner, P. (to BASF AG). US Patent 4,090,946. 23 May 1978. Priority date 12 Jul 1975, German, Federal Republic of (F.R. Germany). 4p.

The invention relates to stabilizers for mineral oils and refinery products such as gas oils, crude oils, and recycle oils to counteract settlement of sediments during storage and particularly during heating. The sediments essentially consist of polymeric substances and also of inorganic sulfur-containing and iron-containing compounds which form during thermal treatment and precipitate either immediately or subsequently during storage or during transport of the refinery products. Once these solid or highly viscous substances have become deposited, they can be removed only with extreme difficulty, for example by mechanical means or by burning off by the use of welding torches. It is an object of the invention to provide stabilizers for mineral oils and refinery products which are universally applicable and are effective in very low concentrations. The stabilizers are alternating copolymers, the structures of which are described diagrammatically. (JRD)

COMBUSTION

REFER ALSO TO CITATION(S) 54495, 54497, 54501

54617 (AD-A—050056) Oxidation kinetics of hydrocarbon fuels. Final report 1 Oct 73—30 Sep 77. Glassman, I.; Dryer, F.L.; Santoro, R.J. (Princeton Univ., NJ (USA). Dept. of Aerospace and Mechanical Sciences). Dec 1977. 48p. (AMS—1359). NTIS PC A03/MF A01.

This report discusses interim results on the elucidation of high temperature oxidation kinetics of hydrocarbon fuels through experimental studies in a turbulent flow reactor. The report details current results particularly on ethane oxidation. Also discussed are results of an exploratory study of low pressure metal/oxidizer flame systems as a source of chemical laser action.

54618 (NTIS/PS—78/0194) Fluidized bed combustion. Volume 1. 1964-1976 (citations from the NTIS data base). Report for 1964-76. Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 224p. NTIS PC N01/MF N01.

These Federally-funded research citations cover the fluidized bed processes for the combustion of coal, oil, and industrial and municipal wastes. The bibliography includes studies on sludge incineration, fluidized bed boilers, nuclear fuel reprocessing, and air pollution control.

54619 (NTIS/PS—78/0195) Fluidized bed combustion. Volume 2. 1977-March, 1978 (citations from the ntis data base). Report for 1977-Mar 78. Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 135p. NTIS PC N01/MF N01.

The bibliography cites studies on fluidized bed processes and processors for the combustion of coal, oil, and industrial and municipal wastes. It also covers sludge incineration, fluidized bed boilers, nuclear fuel reprocessing, and air pollution control by fluidized bed combustion.

54620 (NTIS/PS—78/0196) Fluidized bed combustion. Volume 1. 1970-1976 (citations from the Engineering Index data base). Report for 1970-76. Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 212p. NTIS PC N01/MF N01.

This bibliography of worldwide research reports includes fluidized bed processes and processors for the combustion of oil, coal, and industrial as well as municipal wastes. The citations cover sludge incineration, fluidized bed boilers, and air pollution abatement by fluidized bed combustion. (This updated bibliography contains 205 abstracts, none of which are new entries to the previous edition.)

54621 (NTIS/PS—78/0197) Fluidized bed combustion. Volume 2. 1977-march, 1978 (citations from the Engineering Index data base). Report for 1977-Mar 78. Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 110p. NTIS PC N01/MF N01.

These worldwide citations cover the fluidized bed processes and processors for the combustion of oil, coal, and industrial as well as municipal wastes. It also includes sludge incineration, fluidized bed boilers, and air pollution abatement by fluidized bed combustion. (This updated bibliography contains 103 abstracts, 97 of which are new entries to the previous edition.)

NATURAL GAS

REFER ALSO TO CITATION(S) 55234, 55235, 55301, 55938

RESERVES

REFER ALSO TO CITATION(S) 54527, 54528

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 54529, 54530, 54531, 54532, 54533, 54635

54622 (ORO—5203-6) **Geologic and geochemical studies of the New Albany Group (Devonian black shale) in Illinois to evaluate its characteristics as a source of hydrocarbons. Quarterly progress report, January 1—March 31, 1978.** Bergstrom, R.E.; Shimp, N.F. (Illinois State Geological Survey, Urbana (USA)). 1978. Contract EY-76-C-05-5203. 61p. Dep. NTIS, MF A01.

Portions of document are illegible.

Project work is reported in sections on geological evaluation studies, mineralogic and petrographic characterization, physical characterization, geochemical characterization, separation methods development, surface area measurements, methane adsorption measurement, and data processing. (JRD)

54623 (ORO—5203-12) **Geologic and geochemical studies of the New Albany Group in Illinois (Devonian black shale) to evaluate its characteristics as a source of hydrocarbons. Annual report, October 1, 1976—September 30, 1977.** Bergstrom, R.E.; Shimp, N.F. (Illinois State Geological Survey, Urbana (USA)). 1977. Contract EY-76-C-05-5203. 188p. Dep. NTIS, PC A09/MF A01.

The Illinois State Geological Survey is conducting geological and geochemical investigations to evaluate the potential of New Albany Group shales as sources of hydrocarbons. Geological studies include stratigraphy and structure; mineralogic and petrographic characterization; analyses of physical properties; and development of a computer-based resources evaluation system. Studies include quantitative determination of 49 major, minor, and trace elements; trace element distribution between inorganic and organic phases; hydrocaron characterization; and adsorption/desorption studies of gas through shales. Six cores (five from Illinois and one from western Kentucky) provide the principal data base for these investigations.Using subsurface stratigraphic techniques, twenty-two cross-sections and a preliminary New Albany Group thickness map have been prepared. Isopach maps are in preparation for each of the formations within the New Albany. Black shales predominate in the center of the Illinois Basin, whereas gray shales predominate around the margins of the Basin. A computer data base of over 5000 wells penetrating the New Albany Group has been compiled. Tectonic origins are not postulated for any of the linears, and caution is advised when interpreting linear features in glaciated terrains. Mineralogic and petrographic studies have concentrated on two cores. A preliminary classification of four shales lithofacies based on primary depositional characteristics has been established and related to oxygenation of the bottom environment. Preliminary results of physical index properties; major, minor, and trace elements; and gas compositions have been obtained for three cores. Internal surface area measurements reveal that gray shales have higher ultramicroporosity than do black shales. The gray shales also have high gas diffusion rates and are better reservoir rocks.

54624 Role of buried upheavals in the gas-bearing area of the northern rim of the South Caspian Depression. Tamrazyan, G.P.; Ovnatanov, S.T. *Gazov. Prom-st.;* No. 3, 30-32(Mar 1977). (In Russian).

Plutonic (buried) upheavals of the northern rim of the South Caspian depression are examined. A new promising South-Peschannoye upheaval is recommended for drilling. A structural diagram is given for the lowest beds of Pliocene strata and borehole sites are recommended.

54625 Usloviya formirovaniya gidrodinamicheskikh lovushek gaza. (Conditions for the formation of hydrodynamic natural gas traps). Plotnikov, A.A. Moscow; Izdatel'stvo Nedra (1976). 150p.

The theoretical bases for the mechanism of forming hydrodynamic gas traps are presented, and an examination is made of the hydrodynamic conditions for gas deposit sealing in other types of traps. Geological proof is cited for the formation of hydrodynamic gas traps in nature and the accumulation of industrial amounts of gas in those traps. The formation of a hydrodynamic gas trap is shown to be controlled both by the form of the collector-seam roof structure as well as by te piezoelectric surface form under conditions of piezometric and liquid-gas surface adequacy. In that connection, the hydrodynamic gas trap is formed if the intersection of the seam-collector's roof with the piezo-surface projection towards this seam has a closed appearance. The basis condition for the formation of a hydrodynamic gas trap on a monocline in this connection is a semi-closed piezominimum with an opening to the seam's submersion. Principal attention is given to the method of directed exploration for hydrodynamic gas traps and associated gas deposits. Gas deposits in the hydrodynamic traps are considered to be an important resource for increasing gas reserves. The book is designed for a broad spectrum of specialists in the area of prospecting, exploration and working gas and gas-petroleum fields as well as for instructors of gas and petroleum institutions of higher learning, graduate students, and undergraduates. 9 tables, 60 illustrations, 99 references.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 54539, 54540, 54548, 54555

54626 Utilization of low Btu natural gas. Weisz, P.B.; Zahner, J.C. (to Mobil Oil Corp.). US Patent 4,093,029. 6 Jun 1978. Filed date 24 Mar 1977. 6p.

Natural gas having a high CO_2 content and low heating value is converted to useful and valuable products by the extensive removal of CO_2 followed by conversion of the residue to a liquid product useful as fuel (e.g. methanol) through a process combining steam reforming and conversion of the resultant reformer stream, which contains CO, CO_2, and H_2 to liquid products. The CO_2 removed from the natural gas feed is used, in a preferred embodiment, in tertiary methods of recovery of petroleum from natural reservoirs in which primary and secondary methods are no longer viable.

54627 Mathematical modeling and optimization of a low-temperature condensation system. Kafarov, V.V.; Berlin, M.A.; Gorechenkov, V.G.; Konstantinov, E.N.; Fridt, A.I. *Neft. Khoz.;* No. 3, 41-44(Mar 1977). (In Russian).

The optimization for various petroleum gases are given when parameters are varied in a narrow range as determined by existing basic equipment and modern requirements for product quality and depth of processing as well as during the plotting of available limitations as process parameters for evaluating prospective development of petroleum gas processing technology. 1 table, 5 references.

54628 Effect of the number of perforated apertures and the degree of seam stripping on borehole productivity. Nanivskii, E.M.; Kosukhin, L.D.; Kusaiko, N.N.; Kislov, S.A.; Sergienko, Yu.S.; Syropyatov, V.V. *Gazov. Prom-st.;* No. 3, 32-34(Mar 1977). (In Russian).

The effect that the number of perforated apertures and degree of seam stripping has on borehole productivity is analyzed on the basis of a statistical processing of research results. Recommendations are given for improving the conditions for mining a productive seam. 2 references.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 54506, 54507, 55297, 55298, 55299

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 54567

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 54538

54629 (LA—7320-PR) **Stimulation and characterization of eastern gas shales. Progress report, July—September 1977.** Schott, G.L. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 44p. Dep. NTIS, PC A03/MF A01.

Progress is reported in investigations of the application of metal-lined shaped charges to the chemical explosive stimulation of natural gas wells in Devonian shales, and of the application of rapid analysis by laser pyrolysis—gas chromatography to determine geochemical characteristics of these shales. Results are given of three sets of exploratory tests of the penetration of selected polygranular target materials, including Devonian shale and other rocks having similar density, and a manmade grout simulant. Off-the-shelf copper-lined conical charges and uranium-lined hemispherical charges were tested. Also described is a functioning hybrid (analog/digital) com-

puter treatment of two-dimensional gas delivery from reservoirs subjected to stimulation. The scheme of time-sharing of analog hardware and test problem results for a rectangular geometry are presented. Initial operation of laser pyrolysis equipment and procedures, including gas chromatographic separation and flame-ionization measurement of hydrocarbon products from Devonian shale specimens, is reported.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 55292, 55300

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 54491, 55302

54630 (FEA/T—77/293) **Socioeconomic impacts of an Alaskan natural gas transportation system.** Ting, E.S. (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). 1 Jul 1977. 25p. Dep. NTIS, PC A02/MF A01.

Alternative Alaska natural gas transport systems are examined. It is concluded that the significance of socioeconomic impacts for the overall route decision depends on the weight given to impacts disruptive of social and cultural structure as opposed to economic development considerations. If factors such as adverse effects on native communities and local lifestyles are given primary importance, the Arctic and El Paso routes would tend to suffer in a comparison with Alcan. If more importance is placed on a route which will stimulate the Alaskan economy, the El Paso route clearly has the advantage, followed by Alcan.

54631 **System planning for measuring and control stations.** Binder, U.W.; Baumeister, H. (Ruhrgas A.G., Essen (Germany, F.R.)). *Gas- Wasserfach, Gas-Erdgas;* **119**: No. 2, 71-80(Feb 1978). (In German).

From Discussion meeting of the gas industry; Mainz, Germany, F.R. (10 - 11 Nov 1977).

Measuring and control stations in gas supply networks have well-defined, recurrent functions. According to the individual supply network, certain control and measuring ranges are given in the pressure steps already standardized. It is thus obvious to look for standard structures in designing the stations and to cover the total working range occurring in the supply networks by reasonable selection of control and measuring ranges. In the article the structure to be aimed at for the control and measuring stations is illuminated and ideas are developed for dimensioning the useful piping, on the one hand, and the measuring and control piping on the other. It is shown how by subdividing the station into individual functional modules, standardization of the stations may be obtained. The result is a sensible reduction in the cost of the stations and in their construction time.

54632 **Dynamic on-line gas grid observation, possibilities and chances.** Weimann, A.; Lappus, G. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl und Lab. fuer Steuerungs- und Regelungstechnik). *Gas- Wasserfach, Gas-Erdgas;* **119**: No. 2, 81-86(Feb 1978). (In German).

From Discussion meeting of the gas industry; Mainz, Germany, F.R. (10 - 11 Nov 1977).

With an unsteady gas pipe system calculation, time curves of pressures and flows in the pipe system as a function of time-variable stimulation is represented with high accuracy. This is demonstrated for the code system GANESI. Some requirements for on-line operation are analyzed. With process-accompanying simulation, the actual unsteady state of the gas pipe system in real time may be determined from a relatively small number of incoming measurements. Using a code for unsteady gas pipe system computation, this will be achieved by a state assessment. Testing of process accompanying simulator with measured data from a gas transport pipe 78 km long is presented.

54633 **Transportation of non-stable condensate from the Orenburg field.** Odishariya, G.E.; Klapchuk, O.V.; Klochko, Yu.S.; Slavinskii, V.P. *Gazov. Prom-st.;* No. 3, 28-30(Mar 1977). (In Russian).

Test results are presented for an industrial pipeline transporting gas-liquid mixtures from production point to consumer. A comparison is made of actual pressure distribution along the length of the pipeline with the computed distribution characteristics. The pipeline sections functioning under complicated hydrodynamic conditions have been identified, and recommendations are made for increasing the hydrodynamic effectiveness of the pipeline's operation.

PROPERTIES

54634 (PB—276396) **An evaluation of commercial densimeters for use in LNG (liquefied natural gas).** Siegwarth, J.D.; Younglove, B.A.; LaBrecque, J.F. (National Bureau of Standards, Boulder, CO (USA)). Oct 1977. 52p. (NBS-TN—697). NTIS PC A04/MF A01.

The cryogenic fluids density reference system has been used to evaluate three basic types of densimeters: the vibrating element type, the dielectric cell type and the displacement type. These meters were used to measure densities in liquid methane and liquid methane mixtures with ethane, propane, normal butane, and nitrogen. Measurements were made over the density range from 400 to 480 kg/m^3, temperatures from 108 to 130°K, and pressures from 1 to 3 bar. A hundred measurements were made at various densities, temperatures, pressures, and compositions.

STORAGE

REFER ALSO TO CITATION(S) 54617

OIL SHALES AND TAR SANDS

SITE GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 54623

SITE GEOLOGY

REFER ALSO TO CITATION(S) 54622

54635 (MLM—2530) **Biostratigraphic analysis of core samples from wells drilled in the Devonian shale interval of the Appalachian and Illinois Basins.** Martin, S.J.; Zielinski, R.E. (Mound Facility, Miamisburg, OH (USA)). 14 Jul 1978. Contract EY-76-C-04-0053. 25p. Dep. NTIS, PC A03/MF A01.

A palynological investigation was performed on 55 samples of core material from four wells drilled in the Devonian Shale interval of the Appalachian and Illinois Basins. Using a combination of spores and acritarchs, it was possible to divide the Middle Devonian from the Upper Devonian and to make subdivisions within the Middle and Upper Devonian. The age of the palynomorphs encountered in this study is Upper Devonian.

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 54769

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 54282

SURFACE METHODS

54636 (UCID—17855) **Oil shale project: run summary for small retort Run S-11.** Sandholtz, W.A.; Ackerman, F.J.; Bierman, A.; Kaehler, M.; Raley, J.; Laswell, B.H.; Tripp, L.J. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1978. Contract W-7405-ENG-48. 49p. Dep. NTIS, PC A03/MF A01.

Portions of document are illegible.

Results are reported on retort run S-11 conducted to observe the effects of combustion retorting with undiluted air at relatively rapid burn (retorting) rates and to provide a base case for retorting small uniform shale (Anvil Points master batch -2.5 +- 1.3 cm) with undiluted air. It was found that a 0.6 m^3/m^2/minute superficial gas velocity gave an average rate of propagation of the combustion peak of about 2.7 m/day and an average maximum temperature on the centerline of the rubble bed of 1003°C. Oil yield was 93 percent of Fischer assay. For small uniform shale particles (-2.5 + 1.3 cm) it is concluded that only small losses in yield (92 percent vs 96 percent in Run S-10) result from high retorting rates. Maximum temperature considerations preclude going to higher rates with undiluted air. Without diluent, a larger air flux would give excessive bed temperatures causing rock melting and potential closure to gas flow. In experimental retorts, another problem of excessive temperatures is potential damage to metal walls and in-situ sensors. No advantage is seen to using recycled off-gas as a combustion gas diluent. Inert diluents (e.g. nitrogen or steam) may be necessary for process control, but the fuel values in the off-gas should best be used for

energy recovery rather than burned in the retort during recycle. Another consideration from model calculations is that the use of recycle gas containing fuel components retards the retorting rate and so is undesirable. No further recycle experiments are planned as the results of this run proved satisfactory.

REFINING

54637 Steam pyrolysis of shale oil vacuum distillates for petrochemical intermediates production. Smith, P.D.; Dickson, P.F.; Yesavage, V.F. (Colorado School of Mines, Golden). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 756-764(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Vacuum distillations of shale oil may be worthwhile since it produces a good steam pyrolysis feedstock. Maximum ethylene yield was 28.8% for the simulated in situ distillate and 22.6% for the Tosco II distillate. Yields are as good or better than those obtainable from conventional feedstocks. Severity of cracking is increased by increasing the residence time and temperature. The effect of steam to hydrocarbon ratio cannot be determined from the data. Trends observed with increasing severity were: (a) ethylene yield rises to a maximum, then slowly decreases; (b) propylene and butadiene yields continually decrease; (c) methane and hydrogen yields increase; (d) weight percent solids increased. Short residence times, in general, give the highest yields of valuable components. 2 tables, 4 figs.

HEALTH AND SAFETY

54638 (CONF-780636—8) **Mutagenic components of alternate energy sources.** Epler, J.L.; Guerin, M.R. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 13p. Dep. NTIS, PC A02/MF A01.

From 71. Air Pollution Control Association meeting; Houston, TX, USA (25 Jun 1978).

The feasibility of using short-term mutagenicity assays to predict the potential biohazard of various crude and complex test materials has been examined in a coupled chemical and biological approach. The principal focus of the research has been preliminary chemical characterization and preparation for bioassay, followed by testing in the Salmonella histidine reversion assay described by Ames. The mutagenicity tests are intended to (a) act as predictors of profound long-range health effects such as mutagenesis and/or carcinogenesis, (b) act as a mechanism to rapidly isolate and identify a hazardous biological agent in a complex mixture, and (c) function as a measure of biological activity correlating base line data with changes in process conditions. Since complex mixtures can be fractionated and approached in these short-term assays, information reflection on the actual compounds responsible for the biological effect may be accumulated. Thus, mutagenicity tests will also (d) aid in identifying the specific hazardous compounds involved and in establishing priorities for further validative testing, testing in whole animals, and more definitive chemical analysis and monitoring. This work has emphasized test materials available from the developing synthetic fuel technologies. However, the procedures are applicable to a wide variety of industrial and natural products, environmental effluents, and body fluids. The general applicability of microbial test systems has already been demonstrated, for example, by the use of the assay as a prescreen for potential genetic hazards of complex environmental effluents or products, e.g., tobacco smoke condensates, natural products, hair dyes, soot from city air, fly ash, and (in our work with synthetic fuel technologies) oils and aqueous wastes.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 54463

WASTE RESEARCH AND MANAGEMENT

54639 Reclamation of spent oil shale. Crookston, R.B. (TOSCO Corp., Los Angeles); Merino, J.M. pp 31p, Set No. 5, Paper 7 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

At first glance, the reclamation of processed oil shale, or spent shale as it is often called, may appear a straight-forward procedure, especially since the material basically is the same as the native soils of the oil shale region. To some critics of the oil shale industry, however, revegetation appears to be an impossible task. We at Tosco have spent over a decade studying the properties and problems of the spent shale that results from the use of our Tosco II Process, and developing the knowledge and techniques to reclaim it. We envision disposing of this material by forming it into a stable embankment on the surface, preferably in a shallow canyon or valley, and revegetating the surface with a self-sustaining plant community. Also under serious study are techniques to return the material underground in a form that will allow safe and permanent disposal in completed sections of the oil shale mine itself, although realistic and cost-effective means of accomplishing this remain to be developed. Surface disposal and revegetation, at this time the most efficient method for dealing with processed shale, is discussed in detail.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 54639

NUCLEAR FUELS

REFER ALSO TO CITATION(S) 55234, 55235

RESERVES

REFER ALSO TO CITATION(S) 54359

54640 (DAO—4-TM-10) **Mammoth Mine, Tierra Vieja Mountains, Presidio County, Texas.** Nye, T.S. (Department of Energy, Grand Junction, CO (USA). Grand Junction Office). May 1978. 14p. Dep. NTIS, PC A02/MF A01.

The Mammoth mine is located in the Tierra Vieja Mountains, approximately 60 miles south of Van Horn, Presidio County, Texas. The region is composed of highly faulted, moderately folded sedimentary rocks, tuffs, flows, and flow breccias of Upper Cretaceous and Tertiary age. The original structures of the region are well preserved and serve to control the existing drainage pattern. The only known igneous intrusives in the immediate area consist of a few diabase dikes which generally follow major structural trends of the region. Uranium occurs at the Mammoth mine as spherical, acicular aggregates of uranophane in vesicles in a welded, rhyolitic tuff member of the volcanic series of lower Tertiary age. This welded tuff is overlain and underlain by less well consolidated tuffs, conglomerates, and sandstones. Structurally, the Mammoth mine is located at or near the intersection of several faults. The mine workings have exposed numerous small faults with accompanying gouge, breccia, and fracturing. At least one fault has been mineralized but most are barren. Three general themes of origin for the uranium in the welded tuff are readily apparent: deposition of uranium in the vesicles of the tuff by gases and solutions during the cooling of the tuff; leaching of uranium from overlying tuffs and concentration by groundwater; and introduction by hydrothermal solutions. Development and exploration of the deposit are still at a preliminary stage, and more definite information must be obtained before final conclusions can be made concerning the source of the uranium and its method of emplacement.

54641 (LA-tr—78-33) **New data on the geological environment of reactors.** Gauthier-Lafaye, F.; Besnus, Y.; Chauvet, R.; Michel, B.; Weber, F. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Sedimentologie et Geochimie de la Surface; Franceville Co. of Uranium Mines, Mounana (Gabon)). 1978. Translation of IAEA-TC—119/3. (CONF-771222—14). 48p. Dep. NTIS, MF A01.

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

Portions of document are illegible.

Since the Libreville symposium in 1975 our knowledge of the geological environment of reactors has progressed within the framework of a larger study of the uraniferous deposits of Franceville. In the Oklo deposit a fine stratigraphy of the "C 1 layer" (mineralized uraniferous layer) has been established and this allows the natural reactors to be located again stratographically. Tectonic analysis of the Oklo deposits reveals the particular features of the Oklo structure and of the reaction zones located in shear chutes. The petrographic studies reveal two types of ore formed in distinct waves. In the first case the role of organic materials seems to predominate, while in the second case migrations of oxidizing solutions are the cause of reconcentrations. Finally, a geochemical study done on specimens from Oklo and Okelobondo reveal the existence of an "isolated" geochemical phase which contains uranium and a certain number of trace elements. This phase is combined with organic material. This

study also deals with the problem of the migration of lead to Oklo and Mounana.

54642 Geology and genesis of the uranium mineralization of the Oos trough in the northern Black Forest. Kneuper, G.; List, K.A. (Saarberg-Interplan G.m.b.H., Saarbruecken (Germany, F.R.)); Maus, H. (Geologisches Landesamt Baden-Wuerttemberg, Freiburg im Breisgau (Germany, F.R.)). *Erzmetall;* **30**: No. 11, 522-525(Nov 1977). (In German).

During uranium prospecting work in the northern Black Forest, signs of sedimentary uranium ore deposits were found. The findings were arkose, sandstone, and argillacious slate of the upper carbon, deposited in the southern region of the Oos trough. The main carrier of mineralization is finely distributed pitchblende of different ages. Fortified exploration work is continued.

54643 Outlook for uranium and enrichment supply in the United States. Cherry, B.H. (General Public Utilities Corp., Parsippany, NJ). *Proc. Am. Power Conf.;* **39**: 100-106(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

It should be noted that it is fuel-cycle considerations which determine the significant benefits which nuclear power has to offer. Ironically, it is also fuel-cycle considerations which are currently impeding the growth of the industry. In order for United States nuclear programs to move forward efficiently, current uncertainties surrounding the front end of the fuel cycle must be reduced. Commitments for new nuclear power plants are being impeded in a major way by the potential unavailability of enriched uranium. The utility buyer and his customers must come to grips with the reality of the uranium market and be prepared to further integrate their activities into uranium supply. Utility regulators must be educated in order to provide the basis for such integration. While the uranium resource base appears to be adequate, the interest and ability of the uranium industry to define and produce required uranium is a major unknown. The stewardship of current and projected enrichment capacity has had a severe and negative impact on the cost and availability of enriched uranium; unless significant charges are made in the key area, difficulties are likely to persist.

54644 Stages of hydrothermal mineralization of molybdenum-uranium ore manifestation in volcanic edifice. Yakovlev, P.D.; Mamotin, S.A. (Moskovskij Geologorazvedochnyj Inst. (USSR)). *Zap. Vses. Mineral. O-va.;* No. 3, 247-254(May 1976). (In Russian).

Volcanogenic-intrusive complex of the ore manifestation region is represented by various facies of liparite and granitoid formation rocks. Numerous dislocations with breaks in continuity and the corresponding feathering fissures relate to 3 stages of hydrothermal mineralization of rocks. Quartz-sericite-kaolin metasomatites were formed at the earlier (volcanic) stage. Tourmalinization was associated with the middle stage which accompanied the granitoid intrusive formation. The later mineralization stage was accompanied by formation of beresites and molibdenum-uranium ores. Identification was controlled by the dislocation, ore bodies had the shape of lens, vein or small nest. 7 stages separated by shores were identified at the ore stage: quartz-sericite pyritic; quartz-pyrite-arsenopyritic; sulfide-pitchblendic; chalcedonic; ankeritic; quartz-calcitic and pyrite-ankeritic.

EXPLORATION

REFER ALSO TO CITATION(S) 54463

54645 Experimental pit Muellenbach as a test area for prospecting and exploration techniques and for radiation protection in uranium ore mining. Ertle, H.J.; Gerlach, R.; Mueller, H. (Saarberg-Interplan G.m.b.H., Saarbruecken (Germany, F.R.)). *Erzmetall;* **30**: No. 11, 526-530(Nov 1977). (In German).

The deposits at Muellenbach are in an advanced phase of exploration. It is planned to compare measuring methods of prospecting and exploration techniques with underground measuring methods, the aim being to derive at regularities for these types of deposits. - Another goal is the development and the testing of a mining technique which falls in with the requirements of radiation protection.

54646 (GJBX—26(78)(Vol.1)) **Aerial gamma ray and magnetic survey: Rice Lake Quadrangle, Wisconsin; Iron Mountain Quadrangle, Wisconsin/Michigan; Eau Claire Quadrangle, Wisconsin/Minnesota; and Green Bay Quadrangle, Wisconsin. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Apr 1978. Contract EY-76-C-13-1664. 203p. Dep. NTIS, PC E09/MF E09.

Under the National Uranium Resource Evaluation (NURE) Program, a high sensitivity airborne radiometric and magnetic survey was conducted of the Rice Lake, Iron Mountain, Eau Claire and Green Bay 1:250,000 NMTS Quadrangles within the states of Wisconsin, Michigan, and Minnesota. A total of 10,340 line miles were collected within these quadrangles. All data are presented in this report as corrected profiles of all radiometric variables, magnetic data, radar and barometric altimeter data, air temperature and airborne Bismuth contributions. Radiometric data presented are corrected for Compton Scatter, altitude dependence and atmospheric Bismuth. These data are also presented on microfiche, and digital magnetic tapes. In addition, anomaly maps and interpretation maps are presented relating known geology or soil distribution to the corrected radiometric/magnetic data. Even though there is extensive cover (glacial cover, lakes, etc.) within the area, the pseudo-contour maps clearly delineate areas of relative high counting rates which generally correspond to statistical uranium anomalies.

54647 (GJBX—26(78)(Vol.2)) **Aerial gamma ray and magnetic survey: Rice Lake Quadrangle, Wisconsin. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Apr 1978. 160p. Dep. NTIS, PC A08/MF A01.

Data obtained from a high sensitivity airborne radiometric and magnetic survey of the Rice Lake Quadrangle in Wisconsin are presented. All data are presented as corrected profiles of all radiometric variables, magnetic data, radar and barometric altimeter data, air temperature and airborne Bismuth contributions. Radiometric data presented are corrected for Compton Scatter, altitude dependence and atmospheric Bismuth. These data are also presented on microfiche, and digital magnetic tapes. In addition, anomaly maps and interpretation maps are presented relating known geology or soil distribution to the corrected radiometric/magnetic data.

54648 (GJBX—26(78)(Vol.2)(E)) **Aerial gamma ray and magnetic survey: Eau Claire Quadrangle, Wisconsin/Minnesota. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Apr 1978. Contract EY-76-C-13-1664. 158p. Dep. NTIS, PC A08/MF A01.

Data obtained from a high sensitivity airborne radiometric and magnetic survey of the Eau Claire Quadrangle in Wisconsin/Minnesota are presented. All data are presented as corrected profiles of all radiometric variables, magnetic data, radar and barometric altimeter data, air temperature and airborne Bismuth contributions. Radiometric data presented are corrected for Compton Scatter, altitude dependence and atmospheric Bismuth. These data are also presented on microfiche, and digital magnetic tapes. In addition, anomaly maps and interpretation maps are presented relating known geology or soil distribution to the corrected radiometric/magnetic data.

54649 (GJBX—26(78)(Vol.2)(G)) **Aerial gamma ray and magnetic survey: Green Bay Quadrangle, Wisconsin. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Apr 1978. Contract EY-76-C-13-1664. 198p. Dep. NTIS, PC A09/MF A01.

Data obtained from a high sensitivity airborne radiometric and magnetic survey of Green Bay Quadrangle in Wisconsin are presented. All data are presented as corrected profiles of all radiometric variables, magnetic data, radar and barometric altimeter data, air temperature and airborne Bismuth contributions. Radiometric data presented are corrected for Compton Scatter, altitude dependence and atmospheric Bismuth. These data are also presented on microfiche, and digital magnetic tapes. In addition, anomaly maps and interpretation maps are presented relating known geology or soil distribution to the corrected radiometric/magnetic data.

54650 (GJBX—26(78)(Vol.2)(IM)) **Aerial gamma ray and magnetic survey: Iron Mountain Quadrangle, Wisconsin/Michigan. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Apr 1978. Contract EY-76-C-13-1664. 174p. Dep. NTIS, PC A08/MF A01.

Data obtained from a high sensitivity airborne radiometric and magnetic survey of Iron Mountain Quadrangle in Wisconsin/Michigan are presented. All data are presented as corrected profiles of all radiometric variables, magnetic data, radar and barometric altimeter data, air temperature and airborne Bismuch contributions. Radiometric data presented are corrected for Compton Scatter, altitude dependence and atmospheric Bismuth. These data are also presented on microfiche, and digital magnetic tapes. In addition, anomaly maps and interpretation maps are presented relating known geology or soil distribution to the corrected radiometric/magnetic data.

54651 (GJBX—50(78)(Vol.2a)) **Aerial gamma ray and magnetic survey: Peninsula Portion, Hancock Quadrangle, Michigan. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). May 1978. Contract EY-76-C-13-1664. 16p. Dep. NTIS, MF A01.

Portions of document are illegible.

Data generated by an aerial gamma ray survey of the Peninsula Portion, Hancock Quadrangle, Michigan, are presented. (LK)

54652 (GJBX—50(78)(Vol.2)(AQ)) **Aerial gamma ray and magnetic survey: Ashland Quadrangle, Wisconsin/Michigan/Minnesota. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). May 1978. Contract EY-76-C-13-1664. 73p. Dep. NTIS, MF A01.

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^{208}Tl, ^{214}Bi, ^{40}K, and their ratios were determined. Tl, U, K, and their ratios were determined in the soils. (DLC)

54653 (GJBX—50(78)(Vol.2)(HQ)) **Aerial gamma ray and magnetic survey: Peninsula Portion, Hancock Quadrangle, Michigan. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). May 1978. Contract EY-76-C-13-1664. 31p. Dep. NTIS, MF A01.

Portions of document are illegible.

This document consists of graphs of: altitude, resid mag gammas, Bi air correction, ^{208}Tl, ^{214}Bi, ^{40}K, total acounts, Bi/Tl, Bi/K, Tl/K, K anomaly, U anomaly, Th anomaly, Th/K anomaly, U/K anomaly, and U/Th anomaly. (DCL)

54654 (GJBX—50(78)(Vol.2)(IR)) **Aerial gamma ray and magnetic survey: Iron River Quadrangle, Michigan/Wisconsin. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). May 1978. Contract EY-76-C-13-1664. 83p. Dep. NTIS, MF A01.

Portions of document are illegible.

Data generated in an aerial gamma ray and magnetic survey of the Iron River Quadrangle, Michigan/Wisconsin, are presented. Included are anomaly maps and flight paths. (LK)

54655 (GJBX—50(78)(Vol.2)(MQ)) **Aerial gamma ray and magnetic survey: Marquette Quadrangle, Michigan. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). May 1978. Contract EY-76-C-13-1664. 74p. Dep. NTIS, MF A01.

Portions of document are illegible.

^{208}Tl, ^{214}Bi, ^{40}K, and their ratios were determined in flight lines. Maps are given for the K, U, Th anomalies and their ratios. Separate Th, U, K, and ratio graphs are included for each formation. (DLC)

54656 (K/UR—103) **Hydrogeochemical and Stream Sediment Reconnaissance basic data for Eau Claire NTMS Quadrangle, Wisconsin; Minnesota.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 15 Jun 1978. Contract W-7405-ENG-26. 142p. (GJBX—94(78)). Dep. NTIS, MF A01.

Portions of document are illegible.

Results of a reconnaissance geochemical survey of the Eau Claire Quadrangle, Wisconsin/ Minnesota, are reported. Field and laboratory data are presented for 565 groundwater samples, 680 stream sediment samples, and 667 stream water samples. Statistical and areal distributions of uranium and other possible uranium-related variables are displayed. A generalized geologic map of the survey area is provided and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Based on results from groundwater, stream sediment, and stream water samples, the most favorable area for uranium mineralization within the Eau Claire Quadrangle is located in the northeast corner of the quadrangle. This area is dominated by undifferentiated igneous and metamorphic rocks, Precambrian in age and felsic in composition. Another area delineated by results from groundwater and stream water data is located in the southwest corner of the quadrangle. The dominant geologic unit in the area is the Prairie du Chien Group which consists primarily of dolomite. The high values of uranium occurring in this area are attributed to the high dissolved solid content of the water due to the dissolution of the dolomite.

54657 (K/UR—105) **Hydrogeochemical and Stream Sediment Reconnaissance basic data for San Antonio NTMS Quadrangle, Texas.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 22 Jun 1978. Contract W-7405-ENG-26. 141p. (GJBX—98(78)). Dep. NTIS, MF A01.

Portions of document are illegible.

Results of a reconnaissance geochemical survey of the San Antonio Quadrangle, Texas, are reported. Field and laboratory data are presented for 781 groundwater samples, 541 stream sediment samples, and 331 stream water samples. Statistical and areal distributions of uranium and other possible uranium-related variables are displayed. A generalized geologic map of the survey area is provided and pertinent geologic factors which may be of significance in evaluating the potential for uranium mineralization are briefly discussed. Based on results from groundwater and stream water samples, extensive areas within the San Antonio Quadrangle are producing water from saline environments. These areas are located southeast of the Balcones Escarpment. These saline environments delineate a northeast-southwest trend which coincides predominately with the outcrop of the Upper Cretaceous Formations and the formations of the Midway and Wilcox Groups of Tertiary Age. Results from stream sediment samples indicate that high uranium values occur predominately in the southeast corner of the quadrangle. The high values of uranium that occur in this area are associated with the Tertiary Formations, most notably the Carrizo Sand of the Claiborne Group. High uranium values associated with the Carrizo Sand appear to be related to heavy and/or resistate minerals.

54658 (LA—6844-MS) **Uranium Hydrogeochemical and Stream Sediment Reconnaissance data from the area of the Teller, Bendeleben, Candle, and Kateel River Quadrangles, Seward Peninsula and vicinity, Alaska.** Sharp, R.R. Jr.; Hill, D.E. (Los Alamos Scientific Lab., NM (USA)). May 1978. Contract W-7405-ENG-36. 166p. (GJBX—85(78)). Dep. NTIS, PC A08/MF A01.

During July-August 1976, 2026 natural waters and 2085 bottom sediments were collected from 2209 sample locations (at a nominal density of one location each 23 km^2) on streams and small lakes throughout the Teller, Bendeleben, Candle, and western one-third of the Kateel River NTMS quadrangles, Alaska. Total uranium was measured in the waters by fluorometry and in the sediments and a few waters by delayed-neutron counting. The uranium content of the waters ranged from below the detection limit of 0.02 parts per billion (ppB) to a high of 14.50 ppB, averaging 0.44 ppB, and that of the sediments ranged from a low of 0.2 parts per million (ppM) to a high of 107.4 ppM, averaing 3.93 ppM. The uranium data for water and sediment are separately presented--as computer listings that include pertinent field measurements from each location, as graphically portrayed concentration overlays at 1:250,000 scale for each quadrangle, and as reduced figures showing contours drawn at various concentration levels for each quadrangle--and their areal distributions are compared and correlated with the known features and uranium showings. A test of increasingly detailed methods of data evaluation shows that the more extensive the evaluation, the more useful the reconnaissance uranium data are likely to be. The validity and potential usefulness of the HSSR uranium data are conclusively substantiated by the fact that evidence of all 23 of the reported uranium showings in the 50,000-km^2 study area can be discerned. Several new locations of interest for further field investigation are identified in each of the quadrangles, and most notably in the Bendeleben Mountains. However, the data presented would appear equally useful in guiding field investigation around the uranium occurrences already known, as noteworthy samples often come from close by but on tributary drainages adjacent, opposite, or above them.

54659 (LA—6845-MS) **Uranium hydrogeochemical and stream sediment reconnaissance data from the area of the Shishmaref, Kotzebue, Selawik and Shungnak Quadrangles, northern Seward Peninsula and vicinity, Alaska.** Warren, R.G.; Hill, D.E.; Sharp, R.R. Jr. (Los Alamos Scientific Lab., NM (USA)). May 1978. Contract W-7405-ENG-36. 292p. (GJBX—86(78)). Dep. NTIS, PC A13/MF A01.

During the summer of 1976, 1336 water and 1251 sediment samples were collected for Los Alamos Scientific Laboratory (LASL) from 1356 streams and small lakes or ponds within Shishmaref, Kotzebue, Selawik, and western portion of Shungnak NTMS quadrangles in western Alaska. Both a water and sediment sample were generally obtained from each location at a nominal location density of 1/23 km^2. Total uranium was measured in waters by fluorometry and in sediments and a few waters by delayed neutron counting at LASL. Uranium concentrations in waters have a mean of 0.31 ppB and a maximum of 9.23 ppB, and sediments exhibit a mean of 3.44 ppM and a maximum of 37.7 ppM. A large number of high-uranium concentrations occur in both water and sediment samples collected in the Selawik Hills. At least two locations within the Selawik Hills appear favorable for further investigation of possible uranium mineralization. A cluster of high-uranium sediments, seen in the Waring Mountains, are probably derived from a lower Cretaceous conglomerate unit which is assocated with known airborne radiometric anomalies. Apparently less favorable areas for further investigation of possible uranium mineralization are also located in the Waring Mountains and Kiana Hills. Additional samples were collected within the Shungnak quadrange to increase the sampling density used elsewhere in the area to about one location per 11 km^2 (double-density). Contoured plots of uranium concentrations for both waters and sediments were prepared for all double-density sample locations, and then for the even-numbered and odd-numbered locations separately. These plots indicate that the HSSR sampling density of 1/23 km^2 used in lowland areas of Alaska provide essentially the same definition of relative areal uranium distributions in waters and sediments as seen when the density is doubled. These plots indicate that regional distribution patterns for uranium are well defined without selective sampling of geologic units.

54660 (LA—6846-MS) **Uranium hydrogeochemical and stream sediment reconnaissance data from the area of the Noatak and portions of the Baird Mountains and Ambler River Quadrangles, Alaska.** Aamodt, P.L.; Hill, D.E.; Sharp, R.R. Jr. (Los Alamos Scientific Lab., NM (USA)). May 1978. Contract W-7405-ENG-36. 186p. (GJBX—87(78)). Dep. NTIS, PC A09/MF A01.

During August 1976, a total of 876 natural waters and 861 bottom sediments were collected at a nominal density of one location each 23 km^2 from streams and small lakes throughout the Noatak NTMS quadrangle, the southern two-thirds of the Baird Mountains NTMS quadrangle, and in the southwest corner of the Ambler River

NTMS quadrangle. These samples were collected as part of the National Uranium Resource Evaluation program in Alaska being conducted by the Los Alamos Scientific Laboratory (LASL). The field collection and treatment of the samples were performed following strict LASL specifications. Total uranium was measured in the waters by fluorometry and in the sediments by delayed-neutron counting, using stringent quality assurance controls at the LASL. The uranium contents of the waters ranged from below the detection limit of 0.02 parts per billion (ppB) to a high of 8.38 ppB, and the uranium contents of the sediments ranged from a low of 0.3 parts per million (ppM) to a high of 34.0 ppM. In general, the locations of waters containing relatively high uranium contents were found to occur in clusters, and particularly in the headwaters of streams draining the southern slopes of the Baird Mountains. Few sediments contained relatively high uranium contents. These usually occurred singly at isolated locations scattered throughout the area. No obvious association exists between the location of high-uranium waters and sediments anywhere in the study area. The geology, mineralogy, and hydrology of this area is only generally described in the literature; therefore, it is difficult to correlate these data with particular aspects of the physical environment where individual samples were collected. However, the data do indicate that certain areas underlaid by Paleozoic sedimentary rocks and granitic intrusives within the Baird Mountains and a quartz-pebble conglomerate in the Waring Mountains may warrant more detailed field investigations.

54661 (LA—7217-MS) **Uranium hydrogeochemical and stream sediment reconnaissance of the Tularosa NTMS Quadrangle, New Mexico.** Broxton, D.E. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 87p. (GJBX—104(78)). Dep. NTIS, MF A01.

Portions of document are illegible.

A total of 338 water and 1877 sediment samples were collected over a 20,700-km² area from 2125 locations at a nominal density of one sample per 10 km². Water samples were collected from wells, streams, springs, and artificial ponds. Sediment samples were collected from streams, springs, natural ponds, and artificial ponds. Arbitrary anomaly thresholds of two standard deviations above the mean were chosen for both water and sediment sample populations. The U concentrations in waters collected in the Tularosa quadrangle range from below the detection limit of 0.2 parts per billion (ppB) to 57.8 ppB. Most clusters of water samples containing anomalously high uranium concentrations were collected from locations in uplifts underlain either by volcanic rocks of the mid-Tertiary Datil group or by sedimentary rocks of late Paleozoic and Mesozoic age. Other groups of anomalous waters are from wells that tap Cenozoic aquifers in the intermontane basins. In those areas where the water-sample location coverage is adequate, the known U occurrences are generally associated with high or anomalous U concentrations in water samples. With the exception of one sample with a U concentration of 67.7 ppM, sediments collected in this study have U concentrations that range between 0.2 and 15.2 ppM. Most sediments with U concentrations above the arbitrary anomaly threshold value are from locations which occur in or parallel outcrops of Precambrian crystalline rock exposed in the San Andres and Oscura Mountains. Other anomalous sediments occur as more discreet groups in areas underlain by mid-Tertiary volcanic rocks of the Datil group. Several anomalous samples from the Mogollon-Datil volcanic field were collected along ring fracture systems that surround large volcanic cauldrons.

54662 (RME—1002) **Results of diamond drilling at the Silver Cliff Mine, Lusk, Wyoming.** Bromley, C.P. (Department of Energy, Grand Junction, CO (USA). Grand Junction Office). May 1978. 30p. Dep. NTIS, PC E02/MF A01.

The Silver Cliff Mine is located in Sec. 7, T. 32 N., R. 63 W., one-half mile west of the town of Lusk, Niobrara County, Wyoming. The mine, a silver and copper producer from 1880 to 1886, was first worked for uranium by E.D. Lorimer from 1919 to 1922. Subsequent uranium mining was done by the Wyoming Uranium Corporation in 1951 and 1952; and Edmund Key Interests and Joel L. Starnes, each working separate leases, during the winter of 1952 and 1953. The rocks at the mine are a pre-Cambrian schist capped by 100 feet of Cambrian quartzite. All of the uranium production at the mine has come from this quartzite. A 65° to 70° reverse fault, called the Silver Cliff Fault, has displaced the foot wall quartzite a maximum of 70 feet downwards. Mesothermal solutions rising along this fault, deposited primary silver, copper, and uranium minerals in the favorable quartzite. Later oxidation formed the present secondary deposits, of which uranophane is the only commercially important mineral now found. The drilling was designed to explore the Silver Cliff Fault for possible uranium ore mineralization below the oxidized zone. A total of 2677.5 feet in 9 holes was drilled by the Special Minerals Branch of the U.S. Bureau of Mines. Core recovery in these holes averaged 98.5 percent and 160 shifts were worked. Drilling commenced on December 5, 1952, and was completed on March 26, 1953. The Silver Cliff Fault was intersected at depths of 100 to 400 feet below the lowest presently accessible workings. Minor anomalies were detected in holes 1 through 5, both on a gamma ray probe and in the core, but none were of commercial size or grade.

54663 (RME—2071) **Uranium occurrences of Gila County, Arizona.** Schwartz, R.J. (Department of Energy, Grand Junction, CO (USA). Grand Junction Office). Jun 1978. Contract EY-76-C-13-1664. 64p. Dep. NTIS, PC A04/MF A01.

Uranium was discovered in Gila County in 1950. Since that date numerous occurrences have been located, but deposits of economic importance are limited to the upper member of the Dripping Spring Quartzite of the younger Precambrian Apache Group. Dikes and thick sills of diabase intrude the Apache group and overlying Cambrian Troy Quartzite. The upper Dripping Spring Quartzite is locally feldspathized adjacent to diabase. At least five northerly trending monoclines are present in the Sierra Ancha area. These monoclines appear to have had some control over the stratigraphic position of the intruding diabase sills. A set of tight N. 20°E E. and N. 70° W. fractures, that appear to be related to either intrusion of the diabase or to the monoclinal folding, controlled the emplacement of ore bodies. Large-scale normal faulting appears to be of post-ore age. Most ore bodies are nearly vertically tabular in shape and coincident with fractures trending roughly N. 20° E. and N. 70° W. Centers of the veins are higher grade with the tenor decreasing outward. Most of the better ore bodies are near diabase and there is a strong suggestion of a genetic relationship to the diabase.

54664 (UCID—16911-78-1) **Hydrogeochemical and Stream-Sediment Reconnaissance survey of the National Uranium Resource Evaluation (NURE) Program: western United States. Quarterly progress report, January—March 1978.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 May 1978. Contract W-7405-ENG-48. 17p. Dep. NTIS, PC A02/MF A01.

During the past quarter, planning and site selection were completed for reconnaissance sampling projects in California, Nevada, and Utah covering 156,000 km² (60,000 mi²). Sample acquisition for these projects and previously prepared reconnaissance sampling projects covering 135,000 km² (52,000 mi²) is scheduled for the summer and fall of 1978. We also completed field work for the Southern California Coast Ranges orientation study. Groundwater programs in Arizona, Nevada, and Washington are continuing on schedule. Sediment-processing contractors prepared 8800 samples for analysis, and 4312 sediment samples were analyzed by delayed neutron counting and instrumental neutron activation analysis. Emission spectrometry analyses were comple.ed for 1410 water samples. New computer codes were developed for data validation, and three orientation study raw data reports were released.

54665 (GJBX—50(78)(Vol.2a)(MQ)) **Aerial gamma ray and magnetic survey: Marquette Quadrangle, Michigan. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). May 1978. Contract EY-76-C-13-1664. 27p. Dep. NTIS, MF A01.

Portions of document are illegible.

These graphs present barometric pressure, air temperature, residual mag gammas, diurnal gammas, and altitude for various flight lines over the quadrangle. (DLC)

54666 (GJBX—26(78)(Vol.2a)(IM)) **Aerial gamma ray and magnetic survey: Iron Mountain Quadrangle, Wisconsin/Michigan. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Apr 1978. Contract EY-76-C-13-1664. 30p. Dep. NTIS, MF A01.

Portions of document are illegible.

This document consists of graphs showing altitude, diurnal gammas, residual mag gammas, air temperature, and barometric pressure along various flight lines. (DLC)

54667 (GJBX—20(78)(Vol.2a)(MQ)) **Aerial gamma ray and magnetic survey: Manhattan Quadrangle, Kansas. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Nov 1977. Contract EY-76-C-13-1664. 30p. Dep. NTIS, MF A01.

Portions of document are illegible.

The graphs are of barometric pressure, air temperature, residual mag gammas, diurnal gammas, and altitude. (DLC)

54668 (GJBX—20(78)(Vol.2a)(HQ)) **Aerial gamma ray and magnetic survey: Hutchinson Quadrangle, Kansas. Final report.** (GeoMetrics, Inc., Sunnyvale, CA (USA)). Nov 1977. Contract EY-76-C-13-1664. 30p. Dep. NTIS, MF A01.

Portions of document are illegible.

Data generated from an aerial gamma ray and magnetic survey of the Hutchinson Quadrangle, Kansas, are presented. (LK)

54669 **Locating underground uranium deposits.** Felice, P.E. South African Patent 77/3076/A/. 23 May 1977. 29p.

A method of locating underground deposits of uranium which comprises placing underground a dosimeter from 5 to 18 mg/cm² thick which is capable of storing energy from alpha particles;

activating the dosimeter to cause it to release said stored energy from alpha particles; and measuring the amount of energy released.

54670 From exploration to operation: overview of Bear Creek Uranium Project. Davis, J.F. (Rocky Mountain Energy Co., Denver). pp 14p, Set No. 16, Paper 4 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

The uranium deposits at Bear Creek are "typical" roll-front type deposits. Uranium was transported to the sites of deposition by alkaline groundwaters, which distinctively altered the channel sandstone conduits. As the orebodies were approached, the alteration changed from the pink hematite staining to a rusty limonite stain. The best mineralization occurs in a "C"-shaped roll at the contact between altered sandstone and finer-grained gray unoxidized sandstone. Wide-spaced drilling soon revealed that both alteration and mineralization were controlled by a complex system of paleochannels. The center of these channels consists of coarse-grained sediments indicating a high energy environment. A facies change to finer grained sediments and eventually to mudstones, occurs both laterally and in a downdip direction. This gives the channel a lenticular cross section. Meanders in the sandstone channel system can also provide permeability and chemical favorability for uranium deposition. This feature is similar to the "nose" of a geochemical cell, but occurs along the margins of the channel. Generally speaking, the overall size of the channel system is important. This simply means the larger the channel system, the greater the volume of ore-bearing solutions from which to concentrate economical deposits. Closely associated to the channel size is the individual sand thickness. Although this thickness may be much greater in the center of the channel, in the major orebodies the roll fronts occur where sand thicknesses approximate 35 feet. The recognition of subtle paleochannel systems and the understanding of how alteration, lithology and concentration of uranium mineralization is ultimately controlled by this channel development was the most important geologic tool in exploration at Bear Creek.

MINING

REFER ALSO TO CITATION(S) 54670

54671 Carbonate leaching of uranium. Wright, C.L. South African Patent 77/3226/A/. 25 May 1977. 8p.

A carbonate leaching process is claimed for the solution mining of subterranean uranium containing formations in which an injection well is drilled and completed within the uranium formation and in which alkaline carbonate uranium leaching solution and sufficient hydrogen peroxide are injected through the injection well into the formation whereby uranium values are produced from production wells.The leaching solution is a mixture of 1-hydroxyethylidene-1, 1-diphosphonic acid and an alkali metal pyrophosphate in a weight ratio of from 1 to 10 to 10 to 1, the amount of said mixture is sufficient to inhibit decomposition of the hydrogen peroxide in the leaching solution.

FEED PROCESSING

REFER ALSO TO CITATION(S) 54680

54672 (ORNL/MIT—267) **Recovery of uranium from phosphate rocks.** Wang, R.D.; Field, L.A.; Gillet d'Auriac, F.S. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice). [nd]. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

The economics of recovering U_3O_8 as the primary product from phosphate rock were investigated. Factored cost estimation, with an accuracy of 30%, results in a production cost of $263 per pound of U_3O_8. Recovery operations include the purchase of beneficiated 32% P_2O_5 rock, H_2SO_4 production from sulfur, and extraction of uranium by the DEPA-TOPO process. Sale of byproducts could reduce the cost significantly, but this is complicated by the possible over-production of H_3PO_4 which results in storage and disposal problems.

ENRICHMENT

REFER ALSO TO CITATION(S) 54643, 54727

54673 Heat exchanger. Seifers, H. (to Linde A.G., Wiesbaden (Germany, F.R.)). German(FRG) Patent 2,617,399/A/. 10 Nov 1977. 15p. (In German).

Heat exchangers for use in uranium enrichment plant are subject to particularly stringent safety requirements and should be capable of being repaired and maintained quickly. It is proposed to improve a heat exchanger which has a roller type of design consisting of heat exchanger tubes arranged around a core tube, which are connected together in tube floors. According to the invention the tube floors are connected solidly to the outer jacket (possibly via intermadiate pieces), while the heat exchanger tubes end at the side near the inside of the jacket in the tube floors. Manufacture can be further simplified if core tube, roller and outer jacket which are solidly connected form a compact unit.

54674 Uranium enrichment by chemical exchange. Gourisse, D.; Guais, J.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Genie Chimique). *Entropie;* **13**: No. 78, 42-47(1977). (In French).

This article presents the new French process for enriching uranium by chemical methods, the development of which was announced at the international conference on the Fuel Cycle, in Salzburg in May 1977. After a brief summary of the necessity for using nuclear energy, the importance of the fuel cycle, and the position of uranium enrichment in this cycle, the situation in the enrichment market is described together with the various enriching processes which are being or can soon be developed industrially on a large scale. A more detailed description is given of the principle of chemical exchange processes. A few important features of the French process from the economical or political aspect are then explained, in particular its non-proliferating nature.

GASEOUS DIFFUSION

54675 Uranium enrichment by gaseous diffusion process. Petit, J.F. (Societe EURODIF, 92 - Bagneux (France)). *Bull. Inf. Sci. Tech. (Paris);* No. 223, 19-29(1977). (In French).

From International conference on nuclear power and its fuel cycle; Salzburg, Austria (2 - 13 May 1977).

Their large existing enrichment military capacities provide the United States a good starting base for the development of a light water nuclear power plants program, which success led to a shortfall in production means. France and the United States possessing the necessary know-how on the gaseous diffusion process have been able to undertake the realization of two industrial programs: the C.I.P.-C.U.P. program in the United States and the EURODIF project in France. The current projection still calls fort the construction of several plants by the year 1990. Large increments in capacities are still expected to come from gaseous diffusion the only industrial process existing nowadays. Several projects such as COREDIF taking into account the improvements in the flexibility, automatization, reliability and a reduced investment, are analyzed. Coupling of new facilities to existing plants has already proven to be of great interest. This situation explains why further investigations concerning the gaseous diffusion are being carried on, together with the study of new processes .

LASER EXCITATION

54676 Process for separating isotopes by selective excitation. Kaldor, Andrew. (to Exxon Nuclear Co., Richland, Wash. (USA)). French Patent 2,308,400/A/. 29 Mar 1976. Priority date 23 Apr 1975, United States of America (USA). 12p. (In French).

This invention concerns a process for separating a compound into at least two parts in each of which the isotopic abundances of a given element differ from those of the isotopes of the same element in the compound used. In the production stage, the invention concerns a process of isotopic selective vibrational excitation of gaseous compounds, preferably of the general formulation MF_6, M being chosen from the group which includes U, S, W, Se, Te, Mo, Re and Tc and preferably from among UF_6 and SF_6 by multiple infra-red photonic absorption, then simultaneous and/or subsequent uptake of electrons by the vibrationally excited compounds so that negative ions are formed which decompose into ionic fragments and are separated from the compounds that are not excited.

FUELS PRODUCTION AND PROPERTIES

54677 (HEDL-SA—1434) **High temperature, low power furnace for processing nuclear fuel.** Bowen, W.W.; Buckman, R.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1978. Contract EY-76-C-14-2170. 5p. (CONF-780622—60). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

A furnace of minimum size, high thermal efficiency, and easy maintenance was designed with 10 kg capacity for fabricating mixed oxide fuels. Two versions were developed for working up to 1800°C and to 1150°C, for the High Performance Fuel Laboratory. (DLC)

54678 (PNCT—831-76-01, pp 136-140) **X-rays fluorescence analysis of ATR fuel cladding tube.** Kondo, I.; Sakai, F.; Nakamura, H.; Ouchi, Yoshifusa; Tsutsumi, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Sep 1976.

In Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works, July—December 1975.

The rapid X-ray fluorescence analysis of both alloying components and impurity elements was studied in the attempt to put it in practical use in connection with the acceptance analysis of the Zircaloy-2 cladding tubes used for ATR fuel. An ATR fuel cladding tube, 14.7 mm ID, 4 m long and cylindrical, was cut into samples of given length. The samples were opened, pressed, cut and made flat tentatively. The cladding tube is tough, and hard to make it a flat plate, so a hydraulic Press with "R" shaped punch was used for making a flat plate, a utensil with "R" devised for this analysis. Load the standard sample prepared and the analytical sample correctly in the sample chamber of the X-ray fluorescence analysis equipment, set the X-ray irradiation area by adjusting the sample mask and the diaphragm of the X-ray tube, and measure the intensity of X-ray fluorescence emitted from the elements to be analysed by irradiating X-ray to the sample under preset conditions. The results obtained were in very good agreement with those of chemical analysis, and the very good reproducibility of the method was also found, so that this X-ray fluorescence method is satisfactory for the rapid analysis of ATR fuel cladding tubes.

54679 (PNCT—831-76-01) **Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works, July—December 1975.** (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Sep 1976. 191p. Dep. NTIS (US Sales Only), PC A09/MF A01.

Analytics were prepared for separate sections.

54680 (RFP-Trans—247) **Device for production of fuel and/or fertile spherical particles of uranium dioxide for breeder elements in nuclear and breeder reactors.** Cramer, J.; Hannen, W. Jul 1978. Translation of German Patent 2,411,745, 7 Oct 1975. 7p. Dep. NTIS, PC A02/MF A01.

UO_2 particles are produced with a diameter of a few 100 μm in the following way: an aqueous solution of uranyl nitrate, urea, and hexamethylenetetramine is added dropwise to a water-insoluble liquid which is at a higher temperature below 100°C. The resulting spherical particles are drawn off, washed off with ammonia solution, pre-dried in air, and sintered for a few hours in a reducing atmosphere at 1200 to 1400°C. An apparatus for feeding the drops of the aqueous solution into the liquid is described. (DLC)

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 54724

54681 (CONF-780819—15) **Development of Ag°Z for bulk ^{129}I removal from nuclear fuel reprocessing plants and PbX for ^{129}I storage.** Thomas, T.R.; Staples, B.A.; Murphy, L.P. (Idaho National Engineering Lab., Idaho Falls (USA)). 1978. Contract EY-76-C-07-1540. 21p. Dep. NTIS, PC A02/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

Tests were conducted to develop Ag-exchanged mordenite (AgZ) for removal of gaseous ^{129}I from nuclear fuel reprocessing plants. The effects of bed depth and hydrogen pretreatment on the elemental (I_2) iodine loading of AgZ were examined. The tests indicated that reduced AgZ (Ag°Z) had about twice the capacity for iodine as AgZ, and at least 15-cm bed depths should be used for loading tests. The effects of H_2O(g), NO, NO_2, and bed temperature on the iodine loading of Ag°Z were determined. The highest loadings were obtained with NO in the gas stream. Water vapor and bed temperature appeared to have no effect on the iodine loadings. Tests were conducted to develop a dry method for in situ regeneration of iodine-loaded Ag°Z. A test bed of Ag°Z was recycled 13 times by loading it with I_2 and stripping the I_2 (as HI) with H_2. A 20 percent loss in iodine capacity was observed by the fourteenth loading. The iodine loadings of lead-exchanged zeolites, which were used to chemisorb HI during the recycle tests, were measured. The iodine vapor pressures at 20°C over the substrates were predicted to be 10^{-6}, 10^{-9}, and less than 10^{-16} atm for Pb-exchanged mordenite, Pb-exchanged faujasite and reduced Pb-exchanged faujasite, respectively. A process-flow diagram was formulated for iodine recovery. Two parallel beds of Ag°Z are used to permit continuous iodine recovery. While one is being regenerated the other recovers iodine. The iodine is chemisorbed as AgI, stripped as HI, and chemisorbed on the lead bed as a form of PbI_2. The Ag beds were sized for a 30-day operation in a fuel reprocessing plant before regeneration. About 5 days would be needed for regeneration. About 2 m^3 of iodine-loaded Pb-exchanged faujasite would be generated each year. The Pb bed would be contained in canisters to permit transfer in and out of the bed holder and storage in 0.2 m^3 (55 gal) drums.

54682 (CONF-780819—16) **Nitrogen oxide absorption into water and dilute nitric acid in an engineering-scale sieve-plate column with plates designed for high gas-liquid interfacial area.** Counce, R.M.; Groenier, W.S.; Klein, J.A.; Perona, J.J. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

The absorption of gaseous NO/sub x/ compounds into water and dilute HNO_3 was studied in a three-stage sieve-plate column with plates designed for high gas-liquid interfacial area. The performance of the column was measured while several operating parameters were varied. The results of the study indicate the importance of three mechanisms in the absorption of gaseous NO/sub x/ (NO_2 + $2N_2O4$ + NO) compounds: (1) the absorption of NO_2/sup */ (NO_2 + $2N_2O4$) which results in production of liquid HNO_3 and HNO_2; (2) the dissociation of the liquid HNO_2 into HNO_3 and gaseous NO; and (3) the gas-phase oxidation of NO to NO_2. A mathematical model based on these mechanisms was developed and is presented to explain the observed phenomena.

54683 (PNCT—831-77-01, pp 57-64) **Some experiments for plutonium nitrate conversion process.** Kaya, A. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Apr 1977.

In Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works, January—June 1976.

Survey was made to seek the optimum conversion process of plutonium nitrate to the dioxide which will be added to the present PNC Reprocessing Plant. Advantages and disadvantages of the following processes are compared and discussed: precipitation method (peroxide, Pu(4) oxalate, Pu(3) oxalate); ion-exchange method (cation exchange, anion exchange); solvent extraction (amine extraction, TBP extraction, Butex): and recycle to the existing reprocessing plant. As a result of the survey, it was concluded that the TBP extraction and the oxalate precipitation of plutonium should be recommended. To confirm this conclusion, the minimum basic tests required were carried out concerning the solubility of plutonium dioxide and the behavior of plutonium oxalate in precipitation, filtration, and calcination. The results of dissolution test of plutonium dioxide powder are presented by the dissolution rate as the function of time and calcination temperature. The results of precipitation, filtration and calcination tests are also briefly presented.

54684 (PNL-SA—6643) **Decontamination and melt densification of fuel hull wastes.** Dillon, R.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1977. Contract EY-76-C-06-1830. 13p. (CONF-771208—6). Dep. NTIS, MF A01.

From Technical seminar on the treatment, conditioning and storage of solid alpha-bearing waste and cladding hulls; Paris, France (5 Dec 1977).

Portions of document are illegible.

Ongoing work in the United States on treatment of cladding hull residues from nuclear fuel dissolution is described. The report proceeds to the description of the Pacific Northwest Laboratories melt densification and decontamination program. On a laboratory scale, a two-step process, initial treatment with 600°C HF—Ar mixtures followed by aqueous decontaminating, has produced effective decontamination. The Inductoslag process has been selected for densitifcation of the predominantly Zircaloy waste stream. The process provides for direct melting of the low density fuel hull residue without intermediate preparation of a consumable electrode. Current efforts are addressed to the design and fabrication of decontamination and melting equipment to be installed in a hot cell and remotely operated.

54685 (TID—28549) **International nuclear service centers: a bibliography.** Petty, G.M.; Yokota, M. (RAND Corp., Santa Monica, CA (USA)). Mar 1978. 19p. Dep. NTIS, PC A02/MF A01.

The literature relating specifically to international nuclear fuel service centers appears to be relatively scarce. The items identified are annotated in this bibliography. In addition studies of various kinds of multinational public enterprises and of one-nation nuclear energy centers are listed without annotation. (JSR)

54686 **Fuel reprocessing.** pp 133-166 of Regional nuclear fuel cycle centres. Basic studies. 1977 report of the IAEA study project. Vol. 2. Vienna; IAEA (1977).

A report based on experience with fuel reprocessing is presented, containing technical and economical data. Characteristics of

LWR and HWR spent fuels is given (table) and the reprocessing process and plant facilities are described. The different stages of the solvent extraction process are described more in detail and the flowsheet for a process based on Purex solvent extraction is given. Specifications on the uranyl nitrate and plutonium nitrate solutions and of end-product uranium oxides and plutonium oxides are given (tables). Radioactive wastes (gaseous, liquid and solid) generated during the reprocessing are considered and methods for their processing are discussed. Finally, cost estimates for construction and operation of fuel reprocessing plants are given.

54687 **Mixed oxide fuel fabrication.** pp 167-191 of Regional nuclear fuel cycle centres. Basic studies. 1977 report of the IAEA study project. Vol. 2. Vienna; IAEA (1977).

This report describes present experience with plutonium recycling in thermal reactors and identifies a model facility and process, taking into account the current state of technology. The model facility is then costed and the information organized for use in the mathematical modeling of the total facility.

54688 **Nuclear fuel reprocessing from a commercial viewpoint.** Dickeman, R.L. (Exxon Nuclear Co., Inc., Belleview, WA). *Proc. Am. Power Conf.;* **39**: 87-93(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The abrupt shift in recent months in United States nuclear power policy has placed the Western World in a confused state but does not alter earlier conclusions by essentially all nations that increased reliance on nuclear power is pivotal to their economy, employment, and growth. The proliferation issue is serious and President Carter's efforts to ensure that multinational controls are made as effective as they can be should be supported. It is recognized that civil nuclear power programs have not spawned any nuclear weapons state and many alternatives superior to recovering and clandestinely diverting products from the civil power fuel cycle are available to nations which are so motivated. Therefore, perspective on both a national and multinational level is needed to regain the industrial commitment and momentum to bring forth this important energy source at the pace which is needed. It is felt that a closed fuel cycle is a major factor and Exxon Nuclear filed more than a year ago with NRC for a construction permit to build a 1500 to 2100 ton per year reprocessing plant and fuel storage facility at a site in Tennessee. A construction permit is anticipated in 1979, start of storage operations in 1982 to 1983, and start of reprocessing operations in 1987. Exxon Nuclear has not completed evaluations of response alternatives should a negative direct impact be imposed by the Government upon this program, its schedule, or its costs. Alternatives could range from the temporary suspension of the licensing phase, now in progress, to termination of these privately-funded industrial efforts.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 54708, 54714, 54724, 55620, 55623, 55624

54689 (AGNS—1040-17) **Emergency response to transportation accidents: an overview.** Darr, D.G. (Allied-General Nuclear Services, Barnwell, SC (USA)). 1978. Contract ET-78-C-09-1040. 8p. (CONF-780506—32). Dep. NTIS, PC A02/MF A01.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

Measures taken to ameliorate the consequences of accidents in transport of radioactive materials are examined: packaging, labeling, regulations, and emergency plans. The last measure is reviewed in more detail: development and implementation of emergency plans, rapid response by organizations, public relations, and revision of regulations vs improving emergency response. (DLC)

54690 (PNL—2564) **Projected spent fuel storage requirements.** Boegel, A.J.; White, M.K.; Willingham, C.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1978. Contract EY-76-C-06-1830. 24p. Dep. NTIS, PC A02/MF A01.

This analysis identifies the post-reactor basin storage capacity requirements between now and 1990 for various combinations of utility actions in order to establish the full range of possible storage requirements. The combined actions of reracking reactor basins, transferring spent fuel within utilities, and relaxing the policy of reserving reactor basin capacity for a full core discharge are insufficient to meet pre-1985 spent fuel storage capacity requirements. Additional storage capacity is required before 1985 for at least 1000 BWR assemblies and 2000 PWR assemblies. Storage capacity must be provided for a minimum of 12,000 BWR assemblies and 7,000 PWR assemblies by 1990. If none of the possible industry actions are taken, additional storage capacity is required for over 23,000 BWR and 17,000 PWR assemblies before 1985 and over 63,000 BWR and 40,000 PWR assemblies by 1990. The amount of spent fuel which would be shipped to a post reactor basin storage facility between 1985 and 1990 depends on whether utilities continue the activities and policies required to meet spent fuel storage requirements before 1985 (no full core reserve, intra-utility fuel shipments) or seek to regain their pre-storage shortage posture (full core reserve capacity, no intra-utility fuel shipments). If utilities take the former approach, storage capacity is required between 1985 and 1990 for approximately 11,000 BWR assemblies and 5,000 PWR assemblies. If the latter philososphy prevails, storage capacity must be provided between 1895 and 1990 for approximately 27,000 BWR assemblies and 23,000 PWR assemblies.

54691 (SAND—77-1257) **Analysis of the radiological risks of transporting spent fuel and radioactive wastes by truck and by ordinary and special trains.** Smith, D.R.; Taylor, J.M. (Sandia Labs., Albuquerque, NM (USA)). Jun 1978. Contract EY-76-C-04-0789. 35p. Dep. NTIS, PC A03/MF A01.

The radiological impacts associated with the transportation of nuclear fuel cycle materials by ordinary and dedicated trains are compared. For a population of 100 light-water reactors, no significant radiological differences between ordinary and special train service were determined.

54692 (SAND—78-0246C) **Waste transportation system plan for geologic nuclear-fuel-cycle waste repositories.** Allen, G.C. Jr.; Dupree, S.A.; Freedman, J.M.; Sutherland, S.H. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 17p. (CONF-780506—38). Dep. NTIS, PC A02/MF A01.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

The Office of Waste Isolation, Union Carbide Corporation sponsored a program for the purpose of developing a waste transportation system plan for the procurement of shipping casks to service federal commercial nuclear waste repositories. The study has been performed by Sandia Laboratories, Albuquerque, New Mexico. Geologic waste repositories will begin cold testing in the mid 1980's and will require prototype shipping casks. Implementation of the plan developed from the cask scoping study will provide licensed prototype truck and/or rail casks with subsequent production units on a schedule that is consistent with repository objectives. Additional activities of the program were: (1) To provide information on the details of how casks affect and are affected by interfacing systems, (2) To prepare conceptual designs for casks to be used in the shipment of high level waste and cladding waste, and (3) To describe operational characteristics, maintenance requirements, and interfaces associated with cask use. The program has resulted in the development of a program plan which can be utilized to procure prototype shipping casks needed to service a geologic waste repository in the mid 1980's. Implementation of the plan should begin now due to the limited manufacturing capacity in the United States. Design, licensing, and fabrication of prototype shipping systems should be completed in a timely manner so as not to eliminate options which are consistent with national policy strictly on the basis of hardware unavailability.

54693 **Spent fuel transport in fuel cycle.** Labrousse, M. (Compagnie Generale des Matieres Nucleaires (COGEMA), 92 - Chatillon (France)). *Bull. Inf. Sci. Tech. (Paris);* No. 223, 55-62(1977). (In French).

The transport of radioactive substances is a minor part of the fuel cycle because the quantities of matter involved are very small. However the length and complexity of the cycle, the weight of the packing, the respective distances between stations, enrichment plants and reprocessing plants are such that the problem is not negligible. In addition these transports have considerable psychological importance. The most interesting is spent fuel transport which requires exceptionally efficient packaging, especially where thermal and mechanical resistance are concerned. To meet the safety criteria necessary for the protection of both public and users it was decided to use the maximum capacity consistent with rail transport and to avoid coolant fluids under pressure. Since no single type of packing is suitable for all existing stations an effort has been made to standardize handling accessories, and future trends are towards maximum automation. A discussion on the various technical solutions available for the construction of these packing systems is followed by a description of those used for the two types of packaging ordered by COGEMA.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 55253

54694 **Overview of the fuel cycle, 1977—1981.** Levenson, M.; Zebroski, E. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.;* **39**: 67-86(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The fuel cycle overview is presented in sections on changes of utilities fuel cycle priorities during the 1977-85 period, alternative fuel cycles, spent fuel storage, U supply, enrichment, LWR fuel performance, improved fuel reliability, research on pellet-cladding interactions, fuel development, fuel rod modeling, mixed oxide fuels, reprocessing, waste disposal, and safeguards. (JRD)

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 55104, 55586

54695 (BNWL-SA—6064) **Risk assessment method for nuclear fuel cycle operations.** Pelto, P.J.; Winegardner, W.K. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1977. Contract EY-76-C-06-1830. 20p. (CONF-770611—39). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; New York, NY, USA (12 Jun 1977).

A method is described for the identification and preliminary evaluation of potential accidents (release sequences) which could lead to the release of radioactive material from nuclear fuel cycle operations. Potential accident sequences are evaluated on the basis of risk. The basic elements of this method are presented along with its application to a conceptual high-level radioactive waste management.

54696 (CONF-780316—13) **Metal matrix encapsulation of waste.** Jardine, L.J.; Steindler, M.J. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 12p. Dep. NTIS, MF A01.

From Waste management fuel cycles; Tucson, AZ, USA (5 Mar 1978).

Portions of document are illegible.

The ultimate disposition of nuclear wastes is frequently mentioned by opponents of nuclear power as an unresolved issue, and it is true that adequate demonstrations of nuclear waste disposal have not been performed. It has been suggested, however, that technology is either available or readily amenable for full-scale radioactive demonstrations once necessary Federal policy and criteria decisions are made. Public acceptance of nuclear power would be enhanced if the uncertainty of nuclear waste disposal is dispelled by successful waste disposal demonstrations under the full scrutiny of the public. It is our opinion that only full-scale radioactive demonstrations of waste disposal would qualify as an adequate demonstration and thereby reduce the antagonism which retards development of nuclear power. Thus, now is the time to initiate such demonstrations and we suggest that the concept of metal encapsulation of solidified high level waste forms be used as the method that can be acceptable to both the public and industry. This paper will briefly introduce the metal encapsulation concept by presenting a process flow sheet for encapsulation of wastes that would be produced by a 5 Mg/day reprocessing plant. Some probable attributes of metal-encapsulated waste forms and glass monoliths and of the fabrication processes for these waste forms will be discussed in order to illustrate the bases for the recommendation that metal encapsulation be the preferred route to achieving successful early demonstrations of nuclear waste disposal.

54697 (NVO—185) **Operational radioactive waste management plan for the Nevada Test Site.** (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA); Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). May 1978. 39p. Dep. NTIS, PC A03/MF A01.

The Operational Radioactive Waste Management Plan for the Nevada Test Site establishes procedures and methods for the safe receiving, processing, burial, or storage of radioactive waste. Included are NTS radioactive waste disposition program guidelines, procedures for radioactive waste management, description of storage areas and facilities and a glossary of specifications and requirements.

54698 (PNL—2377-4) **Nuclear waste management. Quarterly progress report, October—December 1977.** Platt, A.M. (comp.). (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1978. Contract EY-76-C-06-1830. 73p. Dep. NTIS, PC A04/MF A01.

Work on the following is reported: decontamination and densification of chop-leach cladding residues, monitoring methods for particulate and gaseous effluents from waste solidification processes, TRU waste fixation studies, krypton solidification, ^{14}C and ^{129}I fixation, system studies, safety assessment, waste isolation safety assessment program, monitoring and physical characterization of unsaturated zone transport, detection and characterization of mobile organic complexes of fission, and electropolishing for surface decontamination of metals.

54699 (RHO-C—7) **Analysis of the factors that impact the reliability of high level waste canister materials.** Boyd, W.K.; Hall, A.M. (Battelle Columbus Labs., OH (USA)). 19 Sep 1977. Contract EY-77-C-06-1030. 73p. Dep. NTIS, PC A04/MF A01.

The analysis encompassed identification and analysis of potential threats to canister integrity arising in the course of waste solidification, interim storage at the fuels reprocessing plant, wet and dry shipment, and geologic storage. Fabrication techniques and quality assurance requirements necessary to insure optimum canister reliability were considered taking into account such factors as welding procedure, surface preparation, stress relief, remote weld closure, and inspection methods. Alternative canister materials and canister systems were also considered in terms of optimum reliability in the face of threats to the canister's integrity, ease of fabrication, inspection, handling and cost. If interim storage in air is admissible, the sequence suggested comprises producing a glass-type waste product in a continuous ceramic melter, pouring into a carbon steel or low-alloy steel canister of moderately heavy wall thickness, storing in air upright on a pad and surrounded by a concrete radiation shield, and thereafter placing in geologic storage without overpacking. Should the decision be to store in water during the interim period, then use of either a 304 L stainless steel canister overpacked with a solution-annealed and fast-cooled 304 L container, or a single high-alloy canister, is suggested. The high alloy may be Inconel 600, Incoloy Alloy 800, or Incoloy Alloy 825. In either case, it is suggested that the container be overpacked with a moderately heavy wall carbon steel or low-alloy steel cask for geologic storage to ensure ready retrievability. 19 figs., 5 tables.

54700 (BNWL-tr—314) **French program and achievements concerning α waste.** Sousselier, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). May 1978. Translated from pp 29-33 of paper presented at NEA-IAEA technical seminar on the treatment, conditioning, and storage of solid alpha-bearing waste and cladding hulls, Paris, France, December 5—7, 1977. (CONF-771208—5). 9p. Dep. NTIS, PC A02/MF A01.

From Technical seminar on the treatment, conditioning and storage of solid alpha-bearing waste and cladding hulls; Paris, France (5 Dec 1977).

Processes of encasement in asphalt or thermosetting resins continue to be developed in France for treating certain α wastes and particularly for sludge from chemical treatment by coprecipitation, evaporation sludge and used resins. French studies on long-term storage of radioactive wastes concern α waste in particular. Particularly in view of the volume involved, it is believed that the question of permanent storage of α waste must be settled sooner than the question of storing glass blocks. Three methods are being examined: storage in granitic rocks, storage in salt formations, and storage in suboceanic formations. Storage of α waste in geologic formations poses practically no problem of heat release and relatively few problems of irradiation protection during maintenance operations, but it does raise the question, to the greatest extent, of guaranteed long-term confinement. It is believed that storage in suboceanic formations may be particularly advantageous for this type of waste. With regard to granitic rocks, studies conducted have made it possible to determine a certain number of favorable mountain masses and it is proposed that the first depth drillings (1000 to 1500 meters) be made in 1978. The matter of salt formations is somewhat special, since the main problem is the long-term risk of intrusion into the storage area as a result of human activity; for example, possibly as a result of future development of the salt. This risk makes analysis very difficult. Considering the fact that in current practice the greatest amount of plutonium is found in low- and intermediate-level waste, maximum attention must be given to this type of waste, to determining the plutonium content, to recovery of the plutonium contained therein and to reduction of waste volume.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 54681

54701 (BNL—50854) **Solidification of simulated transuranic contaminated incinerator ash wastes using portland type I cement.** Neilson, R.M. Jr.; Colombo, P. (Brookhaven National Lab., Upton, NY (USA); Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1978. Contract EY-76-C-02-0016. 24p. Dep. NTIS, PC A02/MF A01.

A preliminary study was performed to investigate the use of hydraulic cement for the solidification of transuranic (TRU) contaminated incinerator ash wastes. In this work, the compositional phase fields in which acceptable solidification is obtained using portland type I cement were determined for three simulated TRU incinerator ash wastes. These wastes include Battelle Northwest TRU incinerator ash, Rocky Flats plutonium recycle TRU incinerator ash, and Mound Laboratory cyclone incinerator TRU ash $11A^2$. The compressive strengths and set times of selected formulations were measured.

54702 (BNWL-SA—6461) **Semivolatile fission product behavior in high-level waste vitrification.** Hanson, M.S.; McElroy, J.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1977. Contract EY-76-C-06-1830. 20p. (CONF-771139—3). Dep. NTIS, PC A02/MF A01.

From Radioactive effluents from nuclear fuel reprocessing plants seminar; Karlsruhe, F.R. Germany (22 Nov 1977).

The solidification of high-level wastes is being evaluated as a method for final control of high-level nuclear wastes. The high temperatures required in the solidification process cause the volatilization of small amounts of fission products, primarily ruthenium and cesium. In order to determine cleanup requirements, a good understanding must be gained as to the quantities of fission products volatilized and how these quantities relate to operating conditions. The Pacific Northwest Laboratory, operated by Battelle-Northwest for the U.S. Department of Energy, has been investigating ruthenium and cesium volatilization in various calciners. Studies have been made using both simulated (nonradioactive) and radioactive feedstock. The ongoing investigations have indicated that the semivolatile fission product losses are small enough to be controlled by off-gas cleanup treatment. During recent spray calcination of simulated high-level liquid waste, not more than 0.2 percent of the ruthenium and 0.1 percent of the cesium were lost to the off-gas system. Decontamination factors of about 600 for ruthenium and 1150 for cesium have been obtained across the spray calciner.

54703 (PNCT—831-76-01, pp 73-80) **Separation of alpha-nuclides from HLLW, (1). Separation of americium by solvent extraction with M- and D-2EHPA mixture.** Nemoto, S.; Kumada, S.; Tsuzuki, S.; Katayama, H. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Sep 1976.

In Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works, July—December 1975.

Long-lived, alpha-emitting radionuclides, such as americium and cerium, are contained in the High-Level Liquid Waste (HLLW) that arises in the reprocessing of spent reactor fuel. An estimated composition and the schematic flow of HLLW in the PNC Reprocessing Plant are shown. Americium and cerium were selected as the representatives of long-lived α emitter radionuclides and rare earth elements in this study. The solvent extraction separation method seems the best because of its insensitivity to gas generation and the resistivity to radiation. Americium in organic phase was transferred into aqueous phase by the back extraction with DTPA solution, and it could be separated from cerium at pH 3. The separation factor was 180. The schematic flow of the continuous extraction, and the cerium concentration obtained in the co-extraction bank and the separation bank are shown. The decontamination factor of Ce (Am) in the extraction bank was over 4,000. The concentrations of cerium in both the fission product fraction and the Am product fraction were under the detectable limit that corresponded to 10^{-6} mol/l in this experiment, and the yields of cerium were 104.5% in the extraction bank and 100.3% in the separation bank.

54704 Process and apparatus for treating a waste gas including combustible gases and radioactive KR-85. Kamiya, K.; Yusa, H.; Tsuchiya, H. (to Hitachi, Ltd.). US Patent 4,092,133. 30 May 1978. Priority date 27 Jan 1975, Japan. 8p.

Hydrocarbons are removed by combustion from a waste gas including oxygen, hydrocarbons and radioactive krypton-85 (hereinafter referred to as "Kr-85"), which is generated in a nuclear reactor and a fuel recycling plant without adopting the reduction method of oxygen by adding hydrogen; the resultant gas is caused to pass through an activated charcoal layer and Kr-85 is adsorbed to the activated charcoal layer; the rest of gas is discharged to the atmosphere; further oxygen remaining in the activated charcoal layer is returned to a process of removing hydrocarbons; and thereafter Kr-85 adsorbed to the activated charcoal layer is desorbed, condensed and recovered.

54705 Alteration of reactor installation (i.e. radioactive waste treatment facilities) in Tokai Research Establishment of Japan Atomic Energy Research Institute. *Genshiryoku Iinkai Geppo;* **22**: No. 6, 33-36(Sep 1977). (In Japanese).

The report of the Committee on Examination of Reactor Safety to the Atomic Energy Commission of Japan concerning the alteration is given, which is attached to the reply from the commission to the prime minister, and its safety was confirmed. The alteration is to construct two buildings containing the facilities for middle and high level liquid evaporation, asphalt solidification, incineration, and middle and high level solid waste treatment.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 54718, 54719, 54721

54706 (ARH-ST—127) **Nuclear waste tank and pipeline external leak detection systems.** Key, K.T. (Atlantic Richfield Hanford Co., Richland, WA (USA)). Apr 1977. Contract EY-76-C-06-2130. 153p. Dep. NTIS, MF A01.

Portions of document are illegible.

The development of two external waste tank and pipeline leak detection systems based on the electrical potential fields is reviewed. The Boeing system measured the distortion of an imposed ac potential field. The Battelle—Northwest system measured the change in the magnitude of the existing dc potential field generated by the cathodic protection system and the local electrochemical potential near the electrodes in the sediment. It was found that in a dry area the systems can detect as low as 200 liters of leakage. The engineering assistance to the tank farm management in assessing the suspected leakers is also presented.

54707 (LBL—7049) **Swedish-American cooperative program on radioactive waste storage in mined caverns. Technical project report No. 1.** Witherspoon, P.A.; Degerman, O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Swedish Nuclear Industry Group, Stockholm (Sweden)). May 1978. Contract W-7405-ENG-48. 32p. Dep. NTIS, PC A03/MF A01.

The Swedish-American cooperative program of investigations at the Stripa iron-ore mine is the first international effort of its kind in which field work will be carried out aimed at the general problem of underground radioactive waste storage. The program will focus on a number of problems that must be solved in developing the technology needed to design and operate waste repositories in crystalline rock. These involve such items as the appropriate mining techniques for repository construction, the effects of pressure and temperature on rock permeability, in situ rock stress measurements, and geochemical groundwater investigations. Two critical problems that will receive considerable investigation are (1) the effects of elevated temperatures on the geomechanical behavior of granite, and (2) the fracture hydrology of the granite rock mass at Stripa. The investigation of temperature effects will be approached from two standpoints: (1) the short-term effects will be studied by using full-size canisters equipped with electric heaters to simulate the energy output of radioactive waste, and (2) the long-term effects, by using a time-scaled array of electric heaters to simulate the thermal loading on a rock mass over periods of several decades. The purpose of the hydrology studies is to define the surface and subsurface hydrological conditions of the fractured granite mass at Stripa and to determine how these conditions vary as a function of time and temperature. An understanding of the rate at which water is able to seep through the rock walls of an underground opening and of the level of accuracy required for the necessary field measurements is vital to the design of a waste repository.

54708 (PNL—2444) **National Waste Terminal Storage Program: potenial problems in the waste transportation system.** DeSteese, J.G.; Rhoads, R.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1977. EY-76-C-06-1830;W-7405-ENG-26. 30p. Dep. NTIS, PC A03/MF A01.

Potential problems are identified which may impact the planning, organization, and operation of nuclear waste transportation systems serving federal repositories. These system-level problems have the potential of seriously interfering with the overall OWI Transportation/Logistics Study objective of having a viable nuclear waste transportation system in 1985. This report includes recommended action and priority judgments to address these problems and minimize their impact. The potential problems identified as most important have consequences which may impact the overall state of future preparedness for transporting nuclear waste. Other important concerns relate to the imposition of unnecessarily severe and costly restrictions on nuclear waste transportation, public and carrier acceptance, and the involvement of interested parties in planning and decision-making. The major recommendation of this report is that the planning and development of the waste transportation system should be controlled by a central planning activity which anticipates the impact of uncertainties and undesirable events.

54709 (RHO-C—12) **Preliminary evaluation of the characteristics of nuclear wastes relevant to geologic isolation in basalt.** McCarthy, G.J.; Grutzeck, M.W. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). May 1978. Contract EY-77-C-06-1030. 33p. Dep. NTIS, PC A03/MF A01.

The physical and chemical characteristics of radioactive waste which have bearing upon the concept of geologic storage in basalt are reviewed and discussed. Each class of waste form (spent unreprocessed fuel, calcine, glass, and supercalcine) has its own unique characteristics which may or may not affect the concept of final storage of radioactive waste in basalt. These characteristics form the basis for scientific evaluation of the relative merits of each of the waste/basalt pairs.

54710 (RHO-C—13) **Recommendations for codes and standards to be used for design and fabrication of high level waste canister.**

Bermingham, A.J.; Booker, R.J.; Booth, H.R.; Ruehle, W.G.; Shevekov, S.; Silvester, A.G.; Tagart, S.W.; Thomas, J.A.; West, R.G. (Nuclear Services Corp., Campbell, CA (USA)). 26 Jan 1978. Contract EY-77-C-06-1030. 77p. (NSC—1-78-004). Dep. NTIS, PC A05/MF A01.

This study identifies codes, standards, and regulatory requirements for developing design criteria for high-level waste (HLW) canisters for commercial operation. It has been determined that the canister should be designed as a pressure vessel without provision for any overpressure protection type devices. It is recommended that the HLW canister be designed and fabricated to the requirements of the ASME Section III Code, Division 1 rules, for Code Class 3 components. Identification of other applicable industry and regulatory guides and standards are provided in this report. Requirements for the Design Specification are found in the ASME Section III Code. It is recommended that design verification be conducted principally with prototype testing which will encompass normal and accident service conditions during all phases of the canister life. Adequacy of existing quality assurance and licensing standards for the canister was investigated. One of the recommendations derived from this study is a requirement that the canister be N stamped. In addition, acceptance standards for the HLW waste should be established and the waste qualified to those standards before the canister is sealed. A preliminary investigation of use of an overpack for the canister has been made, and it is concluded that the use of an overpack, as an integral part of overall canister design, is undesirable, both from a design and economics standpoint. However, use of shipping cask liners and overpack type containers at the Federal repository may make the canister and HLW management safer and more cost effective. There are several possible concepts for canister closure design. These concepts can be adapted to the canister with or without an overpack. A remote seal weld closure is considered to be one of the most suitable closure methods; however, mechanical seals should also be investigated.

54711 (RHO-ST—10) **Interim report: commercial waste packaging studies. Task 2, high-level waste package acceptance criteria study.** Moore, E.L. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Mar 1978. Contract EY-77-C-06-1030. 50p. Dep. NTIS, PC A03/MF A01.

Technical support studies have been conducted to identify constraints that will be imposed by the waste management system on the design of canisters used to contain and store solidified commercial high-level waste (HLW). The design constraints arise because of the need for a high integrity canister to be compatible with handling equipment and environments at each stage in the HLW package life cycle. The life cycle covers a span of several years from the time the canister is filled with solidified waste until the package is disposed of in a Federal repository. The HLW package life cycle used as a basis for the technical support studies assumed that waste is produced from the reprocessing of uranium recycle pressurized water reactor fuel 160 days out of reactor. It is solidified to form either a borosilicate glass or a stabilized calcine, and placed in a canister for interim storage (either wet or dry) at the fuels reprocessing plant for a period of up to 10 years. The HLW package is then shipped and emplaced in a Federal repository which can be either in salt, basalt, or shale. A set of preliminary high-level waste package acceptance criteria have been developed and are presented. The high-level waste package acceptance criteria study plan is reviewed and the results of the technical support studies are discussed. Areas requiring additional study to firm up the acceptance criteria and to translate them to design criteria are identified.

54712 (SAND—78-1429) **Revised concept for the Waste Isolation Pilot Plant.** Dennis, A.W.; Milloy, J.A.; Scully, L.W.; Shefelbine, H.C.; Stinebaugh, R.E.; Wowak, W.E. (Sandia Labs., Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 44p. Dep. NTIS, PC A03/MF A01.

The quantities of remotely handled wastes that must be handled at the Waste Isolation Pilot Plant have been reduced from 250 x 10^3 ft^3/y to 10 x 10^3 ft^3/y; the capital cost of the facility will be reduced from 534 to 428 million dollars. Changes in the facility design due to the reduction in the amount of remote-handled waste are discussed. If DOE should exercise its option to construct a high-level waste repository concurrently with the construction of the revised design, with both facilities receiving waste in 1985, the combined cost would be about 580 million dollars. However, it is unlikely that significant quantities of high-level waste in a form suitable for geologic disposal would be available until after 1990. (13 figures, 5 tables) (DLC)

54713 (SAND—78-7061) **Waste Isolation Pilot Plant environmental impact report: socioeconomic portion. An outline of the input-output model and the impact projections methodology.** (Adcock (Larry) and Associates, Albuquerque, NM (USA)). Jul 1978. Contract EY-76-C-04-0789. 139p. Dep. NTIS, PC A07/MF A01.

A static model in the form of a regional input-output model was constructed for Eddy and Lea Counties, New Mexico. This modeling process has been used to assess the economic impacts of the following activities and for the following agencies: San Juan Generating Units Nos. 1, 3, and 4 for Public Service Company of New Mexico, and general economic impacts (an ongoing process) for the Bureau of Business and Economic Research, University of New Mexico. The regional modeling process adjusts a national model by means of location quotients and aggregating techniques. The national model, or base model, used in this process contains 407 economic categories or subsectors of the economy, 389 of which represent the private economy, and 18 of which represent activities mostly dealing with the public sector. The 389 identified sub-sectors were used in the modeling process; the government impact was computed after the private sector analysis.

54714 (UCID—17865) **Interim report on nuclear waste depository thermal analysis.** Altenbach, T.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jul 1978. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

A thermal analysis of a deep geologic depository for spent nuclear fuel is being conducted. The TRUMP finite difference heat transfer code is used to analyze a 3-dimensional model of the depository. The model uses a unit cell consisting of one spent fuel canister buried in salt beneath a ventilated room in the depository. A base case was studied along with several parametric variations. It is concluded that this method is appropriate for analyzing the thermal response of the system, and that the most important parameter in determining the maximum temperatures is the canister heat generation rate. The effects of room ventilation and different depository media are secondary.

54715 (Y/OWI/SUB—7278/1) **Iodine-129: a review of its potential impact on the environment.** Poston, J.W. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). May 1978. Contract W-7405-ENG-26. 47p. Dep. NTIS, PC A03/MF A01.

Attention has been drawn to ^{129}I, a radionuclide with a long half-life and the potential for long-term accumulation in the environment as a result of low-level, chronic releases from nuclear facilities such as nuclear fuel reprocessing plants. The metabolic and physiologic data on iodine, as well as the currently accepted metabolic models, are summarized. In addition, projections of iodine-129 production and release, as well as estimates of the potential hazards derived by various authors, are presented and discussed. The implications of these considerations on the deep geologic disposal of ^{129}I are reviewed and summarized. At this time there are limited data available to assess in detail the impact of releases of ^{129}I to the environment from a geologic waste repository. Since this isotope is essentially stable (has a low specific activity because of its long radioactive half-life) it has been generally regarded as not contributing significantly to the total population dose commitment. Therefore, the presence of this isotope in a waste repository should not significantly affect repository design and operation. However, additional research in several areas such as the movement of ^{129}I from a repository to the surface by ground water and the influence on uptake fraction of the incorporation of ^{129}I in foodstuffs would be useful to more accurately quantify environmental effects.

54716 **Safe in salt. Deposits for nuclear waste.** Richter-Bernburg, G. *Bild Wiss.;* **14**: No. 12, 80-100(Dec 1977). (In German).

The geologic history of the 'Germanic Basin', in which saline sediments were piled up in different strata over a period of nearly 100 million years, and the formation of 'salt deposits' as a consequence of tectonic movements (strata bends, dislocations of strata) in the north-west German region are described. As compact rock being 'harnessed' in the ground, mineral salt is completely impermeable to gases and liquids. Its plasticity prevents any formation of pores or crevasses resp. eliminates existing ones. This impermeable quality has been used technically for a long time in order to use solution-mined caverns for the storage of petroleum or gas without containers. Furthermore, for storing radioactive substances it is of particular importance that mineral salt has the highest thermal conductivity of all sedimentary rocks, so that a local heat up will be distributed quickly. All considerations on a safe storage stem from the fact that all actions take place within rock-mechanically homogeneous mineral salt. Bands of different rocks lead to discontinuities and may render a mechanical calculation impossible in some cases. A careful exploration of the internal structure of salt deposits is therefore one of the most important prerequisites for a safe storage of substances to be separated from the biosphere.

54717 **Status of Federal disposal programs.** Howard, J.E. (Boston Edison Co.). *Proc. Am. Power Conf.;* **39**: 94-99(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The status of high level waste management may be characterized as being in the initial period of the implementation phase insofar as the Federal program related to commercial wastes is concerned. A National Terminal Waste Storage (NTWS) program plan has been

developed and geologic field investigations to evaluate and select repository sites for either solidified HLW and/or spent fuel assemblies are in the process of being initiated at several locations. Specific projects leading toward implementation of permanent waste repositories include the ERDA Waste Isolation Pilot Plant (WIPP) at Carlsbad, New Mexico, and the ERDA National Waste Terminal Storage (NWTS) program.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 54713, 55550

54718 (BNL-NUREG—50855) **Evaluation of isotope migration: land burial. Water chemistry at commercially operated low-level radioactive waste disposal sites. Progress report No. 6, July—September 1977.** Colombo, P.; Weiss, A.J.; Francis, A.J. (Brookhaven National Lab., Upton, NY (USA)). Apr 1978. Contract EY-76-C-02-0016. 50p. Dep. NTIS, PC A03/MF A01.

A survey of the Maxey Flats, Kentucky, low-level radioactive waste disposal site was conducted to obtain an overview of the radioactivity in the trench waters for the purpose of selecting specific trenches for comprehensive study. Water samples collected from trenches and wells were analyzed for specific conductance, pH, temperature, dissolved organic carbon, tritium, gross alpha, gross beta, and gamma radioactivities. The results indicate that there are large differences in the composition of trench waters at the site. Several trenches, that represent extreme and average values of the major parameters measured, have been tentatively selected for further study. 10 fig, 6 tables.

54719 (DOE/EV—0005/4) **Formerly utilized MED/AEC sites remedial action program. Radiological survey of the Ashland Oil Company (former Haist property), Tonawanda, New York. Final report.** Leggett, R.W.; Haywood, F.F.; Dickson, H.W.; Anderson, D.L.; Golden, C.A.; Cottrell, W.D.; Fox, W.F. (Oak Ridge National Lab., TN (USA)). May 1978. Contract W-7405-ENG-26. 68p. Dep. NTIS, PC A04/MF A01.

The results of a radiological survey of the former Haist property, Tonawanda, New York, are presented in this report. The property served as a repository for uranium ore tailings during the period 1944—46. It was released for unrestricted use following a survey conducted in 1958 by the Health and Safety Laboratory (HASL), operated then by the Atomic Energy Commission. The property is now owned by Ashland Oil, Inc., and is used for oil refining operations. The survey was undertaken to determine whether the present radiological status of the property is consistent with current radiation protection guidelines and to determine the extent of movement of radioactive residues from the property via natural means such as surface run-off. The survey included measurement of external gamma and surface beta-gamma radiation levels on and near the site; radium and uranium concentrations in the soil on the site; concentrations of radium, uranium, and thorium in water samples collected on the site and in the drainage paths between the site and the Niagara River; radium concentrations in mud samples taken from the drainage areas; and radon daughter levels in the only building on the site. The results indicate that the residues on the site do not pose an immediate health hazard, assuming that residues remain in place (except for normal drainage) and that the site continues to be used in the manner in which it is presently used. However, potential health hazards could result from some uses of the site. In particular, if buildings were to be constructed in certain areas on the site, significant concentrations of radon daughters could develop in these structures.

54720 (DOE/EV—0005/5) **Formerly utilized MED/AEC sites remedial action program: radiological survey of the former Linde Uranium Refinery, Tonawanda, New York. Final report.** Leggett, R.W.; Cottrell, W.D.; Burden, J.; Ryan, M.T. (Oak Ridge National Lab., TN (USA)). May 1978. Contract W-7405-ENG-26. 170p. Dep. NTIS, PC A08/MF A01.

The results of a radiological survey of the Linde Air Products Division of Union Carbide Corporation, Tonawanda, New York, are presented. During the period 1940 to 1948, this site was used for the separation of UO_2 from uranium ores and for the conversion of UO_2 to UF_4. Five buildings were involved in these operations. The survey included measurements of the following: residual alpha and beta-gamma contamination levels in these buildings; external gamma radiation levels at one meter above the surface in these buildings and outdoors throughout the Linde property; radon and radon daughter concentrations in the air in these buildings; uranium, radium, actinium, and thorium concentrations in soil samples taken both onsite and offsite; contamination in surface water on and near the site; and airborne concentrations of uranium, radium, and thorium in the building in which the separation process was carried out. Elevated concentrations of uranium, radium, and/or actinium were found in two of the buildings and outdoors in widely separated areas of the site. Alpha and beta-gamma contamination levels in some areas of the buildings were above limits set by current federal guidelines concerning the release of property for unrestricted use. Elevated external gamma radiation levels were measured at some outdoor locations and in three of the buildings. The concentration of radium in a water sample taken from an old conveyor pit in one of the buildings was in excess of the non-occupational maximum permissible concentration.

54721 (DOE/EV—0005/6) **Formerly utilized MED/AEC sites remedial action program. Radiological survey of the Seaway Industrial Park, Tonawanda, New York. Final report.** Leggett, R.W.; Cottrell, W.D.; Dickson, H.W. (Oak Ridge National Lab., TN (USA)). May 1978. Contract W-7405-ENG-26. 55p. Dep. NTIS, PC A04/MF A01.

The results of a radiological survey of the Seaway Industrial Park, Tonawanda, New York, are presented in this report. The site is adjacent to the former Haist property, which was used to receive residues from uranium processing during the period 1944—46. In 1974 approximately 6000 yd^3 of this residue was transported to Seaway, where it was used as landfill. The survey was undertaken to determine radiation levels and the extent of radioactive materials on the Seaway property, as well as the extent of movement of radioactive residues by natural means such as surface run-off. The survey included measurement of: external gamma radiation on and near the site; beta-gamma radiation at the surface in the most contaminated areas; radium and uranium concentrations in the soil; concentrations of radium, uranium, and thorium in water samples collected from the drainage areas; and radium concentrations in mud samples taken from the drainage areas. The results indicate that the residues on the site do not pose any immediate health hazards. However, potential health hazards could result from some uses of the site. In particular, if buildings were to be built in certain areas on the site, significant concentrations of radon daughters could develop in these structures. 16 figs, 3 tables.

54722 **Health, safety, and environment.** pp 107-122 of Regional nuclear fuel cycle centres. Basic studies. 1977 report of the IAEA study project. Vol. 2. Vienna; IAEA (1977).

This part is concerned with the overall evaluation of the radiological and environmental aspects. It attempts to analyze problems such as: Does the establishment of a large regional center with co-located facilities for storage, reprocessing, fuel fabrication, and waste management create unacceptable radiological and environmental problems. If such a center can be safely designed and operated, what guidance could be given to Member States wishing to explore the potential of an RFCC. For such a venture, what are the key ingredients of an adequate program for the protection of workers and the environment under normal and emergency conditions. The approach has been taken of keeping as many parameters as possible constant while making a comparison between a multinational fuel cycle center and a smaller national fuel cycle center. The following two options are considered: a) A national fuel cycle center with a 100-600t/a reprocessing plant co-located with a 20-120t/a mixed oxide fuel fabrication plant. b) An RFCC with one or more 700-1500t/a reprocessing plants, a 125-300t/a mixed oxide fabrication plant and waste management facilities.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 54691

54723 (Y/OWI/SUB—7278/2) **Measures of equivalent hazard of radionuclides: a survey.** Poston, J.W. (Georgia Inst. of Tech., Atlanta (USA). School of Nuclear Engineering). May 1978. Contract W-7405-ENG-26. 28p. Dep. NTIS, PC A03/MF A01.

The need for methods to evaluate, on a common scale, the impact of radionuclides on man and his environment has long been recognized. This report reviews a variety of special and general formulations intended to meet this need. It reveals that no single formulation exists which will be totally acceptable in its current state of development. However, particular attention is given to several formulations which exhibit a potential for wider application, especially to the impact of a geologic waste repository.

54724 **Criteria in judging criticality safety.** Thomas, W. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). *Atomwirtsch., Atomtech.;* **23**: No. 4, 182-184(Apr 1978). (In German).

When processing or storing nuclear fuels outside of nuclear reactors or critical facilities, any inadvertent establishment of critical conditions represents major hazards, especially for the plant personnel. Hence, one absolute licensing prerequisite to handling fissile material is the top priority of safety against criticality in planning and operating plants of the nuclear fuel cycle. The problems of

criticality safety have been under investigation also the Federal Republic of Germany for more than a decade. Numerous licensing procedures incorporating expertises on criticality safety have been carried out. Parallel with this development there has been an increase in our basis of experience and our computer facilities such that criteria can now gradually be formulated in standards and rules without hampering progress in the field by premature rule making. This contribution presents a survey of the existing basis and the criteria and standards currently applied in the field of critically safety.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 55251, 55801

54725 (ANL—78-27) **Autoradiography as a safeguards inspection technique for unirradiated LWR fuel assemblies.** Brumbach, S.B.; Perry, R.B. (Argonne National Lab., IL (USA)). May 1978. Contract W-31-109-ENG-38. 51p. (ISPO—12). Dep. NTIS, PC A04/MF A01.

A nondestructive autoradiographic method is described which can provide a verification that rods in the interior of unirradiated LWR fuel assemblies contain low-enriched uranium. Sufficient absorber must be used to reduce contributions to image density by beta radiation from ^{238}U daughters. When appropriate absorbers are used, the density of the image of a uranium-containing fuel rod is proportional to the ^{235}U enrichment in that rod. Exposure times as short as 1.5 hours can be achieved by using fast film and intensifying screens. Methods are discussed for reducing contributions to the image density of any single rod from radiation produced by all other rods in the assembly. The technique is useful for detecting missing rods, dummy rods, and rods containing depleted uranium. These defects can be detected by visual inspection of the autoradiographs. In its present state of development, the technique is not sensitive enough to reliably detect the difference between the various ^{235}U enrichments encountered in current BWR fuel assemblies. Results are presented for field tests of the technique at BWR and PWR facilities.

54726 (DPSPU—78-30-8) **Diversion path analysis at the Savannah River Plant.** Schaumann, C.M.; Stanford, C.A.; Thomason, R.S. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1978. Contract EY-6-C-09-0001. 9p. (CONF-780606—14). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

Diversion Path Analysis has been performed for parts of an enriched uranium facility at Savannah River Plant. Results of the analysis have proven helpful for evaluating and improving internal control safeguards in the facility. An abbreviated form of the initial Diversion Path Analysis method was developed for use at Savannah River Plant. It reduces the analysis time and improves presentation of results.

54727 (GAT-NM—18) **Enrichment plant management and safeguards.** Hurt, N.H. (Goodyear Atomic Corp., Piketon, OH (USA)). 27 Jun 1978. Contract EY-76-C-05-0001. 6p. (CONF-780606—15). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

The next increment of enrichment at Portsmouth will be gas centrifuge. The safeguards program at Portsmouth is discussed, including the DYMCAS system, the computerization, and the detectors. Control of the material access areas is discussed. The licensee material surveillance and verification program is also described. (DLC)

54728 (ISPO—26) **Isotopic safeguards statistics.** Timmerman, C.L.; Stewart, K.B. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 25p. (PNL-SA—6595). Dep. NTIS, MF A01.

Portions of document are illegible.

The methods and results of our statistical analysis of isotopic data using isotopic safeguards techniques are illustrated using example data from the Yankee Rowe reactor. The statistical methods used in this analysis are the paired comparison and the regression analyses. A paired comparison results when a sample from a batch is analyzed by two different laboratories. Paired comparison techniques can be used with regression analysis to detect and identify outlier batches. The second analysis tool, linear regression, involves comparing various regression approaches. These approaches use two basic types of models: the intercept model ($y = \alpha + \beta x$) and the initial point model [$y - y_0 = \beta(x - x_0)$]. The intercept model fits strictly the exposure or burnup values of isotopic functions, while the initial point model utilizes the exposure values plus the initial or fabricator's data values in the regression analysis. Two fitting methods are applied to each of these models. These methods are: (1) the usual least squares fitting approach where x is measured without error, and (2) Deming's approach which uses the variance estimates obtained from the paired comparison results and considers x and y are both measured with error. The Yankee Rowe data were first measured by Nuclear Fuel Services (NFS) and remeasured by Nuclear Audit and Testing Company (NATCO). The ratio of Pu/U versus ^{235}D (in which ^{235}D is the amount of depleted ^{235}U expressed in weight percent) using actual numbers is the isotopic function illustrated. Statistical results using the Yankee Rowe data indicates the attractiveness of Deming's regression model over the usual approach by simple comparison of the given regression variances with the random variance from the paired comparison results.

54729 (LA-UR—78-1648) **Nondestructive assay of highly enriched spent fuel.** Phillips, J.R.; Hsue, S.T.; Hatcher, C.R.; Kaieda, K.; Medina, E.G. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 12p. (CONF-780606—9). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

Passive gamma-ray and neutron measurements have been made on irradiated MTR fuel at the Omega West Reactor. Detectors utilized include a Ge(Li) for gamma spectroscopy, a ^{235}U fission chamber for thermal neutrons, and a smaller ^{235}U fission chamber with a beryllium photoneutron converter for detecting gamma-rays above 1.7 MeV. Measurements confirm that burnup can be closely correlated with the $^{134}Cs/^{137}Cs$ ratio. A comparison of activity profiles taken with the three detectors indicates that the method based on (γ,n) reactions in beryllium is a promising technique.

54730 (LA-UR—78-1656) **Efficient analysis of dynamic materials accounting data.** Shipley, J.P. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 13p. (CONF-780606—17). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

Current trends in safeguarding special nuclear materials (SNM) in nuclear fuel cycle facilities portend increasing emphasis on timely collection and analysis of materials accounting data. The availability of more and better data argues for an organized framework of techniques to ensure efficient and complete extraction of information concerning possible diversion of SNM. This paper describes such a framework and presents results obtained by analyzing simulated data from a large nuclear fuel cycle facility.

54731 (LA-UR—78-1957) **Statistical analysis in nuclear accountability: a simulation approach.** Johnson, M.E.; Tietjen, G.L.; Johnson, M.M. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 8p. (CONF-781007—1). Dep. NTIS, PC A02/MF A01.

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

This paper describes a computer simulation approach to modeling material balances and to deriving the limits of error attributable to measurement procedures. A new probability distribution is presented which is useful in the computer simulations. This distribution permits the investigator to assess the sensitivity of initial distributional assumptions on the computed limits of error. The simulation approach is illustrated with a case study example.

54732 (NTIS/PS—78/0272) **Nuclear materials safeguards. volume 2. 1975-February 1978 (a bibliography with abstracts). Report for 1975-feb 78.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 291p.

Citations cover the methods of safeguarding nuclear materials through effective management, accountability, nondestructive assays, instrumentation, and automated continuous inventory systems. Problem areas and recommendations for improving the management of nuclear materials are included. (This updated bibliography contains 286 abstracts, 142 of which are new entries to the previous edition.)

54733 (NUREG/CR—0040) **Evaluation of cost estimates of physical security systems for recycled nuclear fuel.** Hockett, J.M.; Rapczinski, L.A.; Jacobi, L.W.; Zenlea, S. (Mitre Corp., Bedford, MA (USA)). Jan 1978. 172p. NTIS $8.00.

This report is an evaluation of the cost estimates and underlying economic assumptions of physical security systems described in the Draft Safeguards Supplement to the Generic Environmental Statement on the use of Mixed Oxide Fuel in Light Water Cooled Reactors—NUREG 0002, August 1976 (GESMO). It was prepared by The MITRE Corporation under a contract with the Nuclear Regulatory Commission (NRC). The NRC contract number is NRC-04-77-114; the corresponding MITRE project number is 24130.

54734 (PB—277829) **Measurements and standards for nuclear materials safeguards. Quarterly report.** Barnes, I.L.; Ditmars, D.A.; Bean, V.E.; Garrett, D.A.; Bowman, C.D. (National Bureau of Standards, Washington, DC (USA)). Feb 1978. Contract AT(49-25)-9009. 14p. NTIS PC A02/MF A01.

This report is a review of the first quarter, start-up phase of a long-term NBS program sponsored by NRC to up-grade national measurements and standards capability for nuclear materials safeguards. The overall approach that NBS is utilizing to provide for development and dissemination of a consistent set of national measurement standards for nuclear materials safeguards is presented. A summary of the initial start-up progress for each of the five tasks in the project is then given.

54735 (SAND—78-0378C) **Safeguards Automated Facility Evaluation (SAFE) methodology.** Chapman, L.D.; Grady, L.M.; Bennett, H.A.; Sasser, D.W.; Engi, D. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 6p. (CONF-780606—12). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

The SAFE procedure is an efficient method of evaluating the physical protection system of a nuclear facility. Since the algorithms used in SAFE for path generation and evaluation are analytical, many paths can be evaluated with a modest investment in computer time. SAFE is easy to use because the information required is well-defined and the interactive nature of this procedure lends itself to straightforward operation. The modular approach that has been taken allows other functionally equivalent modules to be substituted as they become available. The SAFE procedure has broad applications in the nuclear facility safeguards field as well as in the security field in general. Any fixed facility containing valuable materials or components to be protected from theft or sabotage could be analyzed using this same automated evaluation technique.

54736 (SAND—78-0445C) **International safeguards for critical facilities.** Ney, J.F.; Todd, J.L. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 14p. (CONF-781007—3; IAEA-SM—231/77). Dep. NTIS, PC A02/MF A01.

From IAEA symposium on nuclear material safeguards; Vienna, Austria (2 Oct 1978).

Goal was to detect and confirm the protracted or abrupt diversion of 8 kg Pu ^{235}U within approximately a week of the diversion. The general safeguards alternatives considered were (1) continuous inspections by resident inspectors, with varying degrees of comprehensiveness, (2) periodic inspections by regional inspectors at varying time intervals, (3) unattended containment/surveillance measures, and (4) various combinations of the above. It was concluded that a practical and effective international safeguards system can be achieved by employing a method of continuously monitoring facility activities which could lead to diversion, in addition to routine inspections. Monitoring detects inventory discrepancies and violations of agreed-upon procedural restrictions, as well as unauthorized removal of Special Nuclear Materials (SNM). A special inventory is used following detection to confirm any suspected diversion. Comparison of 28 safeguards options led to the selection of a system for further development which uses a combination of surveillance and inspection by resident IAEA personnel, containment/surveillance by unattended equipment, and routine inventory sampling. A development program is described which is intended to demonstrate the feasibility of several containment and surveillance measures proposed in the study. Included are a personnel portal and an instrument/material pass-through as well as associated recording and tamper protection features.

54737 (UCID—17725) **Material control system simulator program reference manual.** Hollstien, R.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jan 1978. Contract W-7405-ENG-48. 436p. Dep. NTIS, PC A19/MF A01.

A description is presented of a Material Control System Simulator (MCSS) program for determination of material accounting uncertainty and system response to particular adversary action sequences that constitute plausible material diversion attempts. The program is intended for use in situations where randomness, uncertainty, or interaction of adversary actions and material control system components make it difficult to assess safeguards effectiveness against particular material diversion attempts. Although MCSS may be used independently in the design or analysis of material handling and processing systems, it has been tailored toward the determination of material accountability and the response of material control systems to adversary action sequences.

54738 (UCID—17727) **Material control system simulator user's manual.** Hollstien, R.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jan 1978. Contract W-7405-ENG-48. 304p. Dep. NTIS, PC A14/MF A01.

This report describes the use of a Material Control System Simulator (MCSS) program for determination of material accounting uncertainty and system response to particular adversary action sequences that constitute plausible material diversion attempts. The program is intended for use in situations where randomness, uncertainty, or interaction of adversary actions and material control system components make it difficult to assess safeguards effectiveness against particular material diversion attempts.

54739 (UCRL—52441) **PIPE: a computer code for analyzing piping networks.** Morris, G.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Mar 1978. Contract W-7405-ENG-48. 46p. Dep. NTIS, MF A01.

Portions of document are illegible.

The Lawrence Livermore Laboratory is developing for the Nuclear Regulatory Commission a procedure to assess material control and accounting systems to prevent the possible theft of special nuclear materials (SNM). A computer code is described that evaluates the piping network within a plant and identifies all possible paths for removal of SNM from specified sources. As an example movement of plutonium nitrate solution from storage tanks to various exit points is described and simple approximate fluid-flow calculations are given for each path.

54740 (UCRL—80802) **Results of a directed graph and fault tree assessment of a MC and A system.** Gilman, F.M.; Lambert, H.E.; Lim, J.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jun 1978. Contract W-7405-ENG-48. 11p. (CONF-780606—11). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

An assessment of the effectiveness of the Material Control and Accounting System (MC and A) in a hypothetical nuclear facility, the TEST BED is presented. The key in assessing the TEST BED is the generation of adversary event sets. The adversary event sets are generated and analyzed by a directed graph (digraph) and fault tree procedure. Although the TEST BED is a system hardened against SNM theft, the assessment of the TEST BED finds several major weaknesses, and also indicates possible modifications to correct these weaknesses.

54741 (UCRL—80814) **Procedure for the assessment of material control and accounting systems.** Maimoni, A.; Sacks, I.; Cleland, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jun 1978. Contract W-7405-ENG-48. 9p. (CONF-780606—8). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

The current status of the LLL program for MC and A system assessment is reviewed. Particular emphasis is given to the assessment procedure and results. The integrated approach we have taken includes many of the functions normally assigned to physical security. Deceit and tampering are explicitly considered. The results of such a detailed assessment include a systematic identification of adversary targets; the most vulnerable portions of the safeguards system; the number and type of adversaries required, in collusion, to fail the system; and the conditional probabilities of safeguard system failure for a variety of assumptions. The assessment procedure was demonstrated by analyzing a prototype fuel cycle facility, the Test Bed. We believe our methodology will be useful to the NRC as a means of performing detailed, objective assessments. The nuclear industry also should find it valuable as a design tool.

54742 (UCRL—80815) **Material Control System Simulator.** Hollstien, R.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jun 1978. Contract W-7405-ENG-48. 11p. (CONF-780606—10). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

Design and assessment of the material control aspect of nuclear safeguard systems requires consideration of three types of functional elements: (1) material handling or processing, (2) actions of adversaries in their attempt to divert nuclear materials from their normal containment, and (3) components of material control and accounting and physical security systems that detect and respond to stimuli generated by the adversary actions. This paper describes a Material Control System Simulator (MCSS) program that simplifies computer simulation of safeguard systems by providing predefined functional models of these three types of elements. Specification of model systems requires only data pertaining to the performance characterization of these functional elements, so users with no prior computer simulation or programming experience can model and study the dynamic performance of safeguard systems. The paper presents an overview of MCSS and an example diversion attempt simulation that illustrates some of the features of the program.

54743 (UCRL—80818) **Human as a component of a nuclear material safeguard system.** Morgan, D.E.; Schechter, R.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jun 1978.

Contract W-7405-ENG-48. 13p. (CONF-780606—13). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

Many human vigilance experiments are summarized and principles are extracted which should be useful in designing and evaluating a nuclear material safeguard system. A human is a poor observer and is not a dependable part of any man-machine system when required to function as an observer. There are a few techniques which improve his performance by providing feedback. A conceptual model is presented which is helpful in design and evaluation of systems. There is some slight experimental support for the model. Finally, some techniques of time study and statistical control charting will be useful as a means of detecting nuclear diversion attempts.

ADMINISTRATIVE AND REGULATORY

54744 Plutonium recycle's relation to the future of nuclear power. Hoskins, R.E. (Tennessee Valley Authority, Chattanooga). *Proc. Am. Power Conf.;* **39**: 107-114(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

It is noted that the nuclear industry is obligated to furnish imput for informed decision making by government concerning nuclear power. Basic options related to nuclear power are examined. These include abandonment, stagnation, LWR-only options, and LWR/LMFBR tandem options. Comparison of power cost and economic penalties associated with each option is made. (JRD)

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

54745 (UCRL—13814) **Generation of sphere and shell laser fusion targets. Final report, October 1, 1976—November 30, 1977. Report No. 1-78.** Kim, K. (Illinois Univ., Urbana (USA). Charged Particle Research Lab.). 1978. Contract W-7405-ENG-48. 104p. Dep. NTIS, MF A01.

Portions of document are illegible.

The objective of this research is to investigate methods of fabricating sphere and shell laser fusion targets. A hollow hydrogen pellet generator has been constructed, and experiments have been performed to study the effects of system parameters on the production of hollow droplets. Techniques for coating hydrogen pellets with high Z material have been studied, and a system has been constructed to coat spherical solid hydrogen pellets with neon. A preliminary experiment has been performed to freeze the deuterium gas inside a glass microsphere using cold He gas jet. Based on this, two systems have been designed and are under construction to investigate methods of obtaining and retaining uniform D-T layer on the inside surface of a microsphere using cold gas jets.

54746 (UCRL—80269) **Technique for full surface examination of small spheres in the scanning electron microscope.** Ward, C.M.; Hendricks, C.D.; Weinstein, B.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jan 1978. Contract W-7405-ENG-48. 16p. (CONF-780415—5). Dep. NTIS, MF A01.

From Scanning electron microscopy conference; Los Angeles, CA, USA (16 Apr 1978).

Portions of document are illegible.

In response to the increasing severity of target surface finish requirements for laser fusion experiments, it has become necessary to examine spherical targets in the Scanning Electron Microscope prior to laser irradiation on an orderly nondestructive basis. A new sample manipulation technique has been developed which rolls a thin wall sphere through 4π steradians without damage and allows easy recovery by placing the sphere between two parallel plane surfaces formed in silicone rubber on the ends of two 0.9 mm capillaries. Mechanical slides, actuated by normal stage controls, cause the capillaries in contact with the sphere to translate laterally and roll the ball. Using theta Z and theta Y motions, the entire surface of the sphere can be brought into a position for examination. With the capillaries oriented for best secondary electron collection and conductively coated, resolutions comparable with traditional mounting techniques are attained. A side looking tilted crystal Si(Li) detector has been incorporated to increase the utility of the system and allow simultaneous EDX microanalysis.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

54747 Method for separating isotopes. Schlenker, R.F. US Patent 4,093,427. 6 Jun 1978. Filed date 23 Jan 1975. 6p.

A vortex tube for separating isotopes is described. A gas mixture containing the isotopic molecules enters the vortex tube under pressure and is separated into a hot discharge flow stream and a cold discharge flow stream. The hot discharge is enriched in lighter isotopic molecules whereas the cold discharge flow stream is enriched in the heavier isotopic molecules. The vortex tube can be used in a single stage or multistage isotope separation apparatus.

54748 Method of and apparatus for the electrostatic excitation of ions. Stenzel, R.L. (to TRW Inc.). US Patent 4,093,856. 6 Jun 1978. Filed date 9 Jun 1976. 8p.

The invention relates to the separation of isotopes. A selected isotope of an element may be caused to acquire more energy than other isotopes by generating a plasma in a magnetic field and electrically exciting the selected isotope at its resonant frequency. Instead of exciting the desired ion by a variable magnetic field, this is effected by electrostatic excitation. A segmented anode is disposed in the plasma at right angles to the longitudinal axis of the device. Each segment of the anode has applied thereto a voltage varying at desired resonant frequency of the selected isotope so that each segment has a different alternating potential. The potential between the cathode and the anode is a steady dc potential to generate the plasma.

54749 Studies in the separation of nitrogen and oxygen isotopes. Nichols, M.L. Berkeley, CA; Univ. of California (1976). 98p. University Microfilms Order No. 77-15,801.

Thesis (Ph. D.).

A feasibility study was made on a process for enriching ^{15}N and ^{18}O utilizing the adsorption of nitric oxide (NO) on Linde 4A-30 moleuclar seive. The study consisted of the following: (1) determination of the stability of NO on the molecular sieve; (2) measurement of the adsorption isotherms; and (3) measurement of the isotopic distribution between the gas and adsorbed phases. Considerable effort to gain insight into gas adsorption in molecular sieves. Nitric oxide was found to disproportionate to nitrous oxide (N_2O) and nitrogen dioxide (NO_2) quite readily on Linde 5A-50 molecular sieve, but very slowly on Linde 4A-30 molecular sieve. The rate of NO disproportionation of 4A-30 was sufficently slow to serve as the separating medium for the process.

RADIATION SOURCES

OTHER INDUSTRIAL USES

REFER ALSO TO CITATION(S) 55717

54750 Determination of particle movement parameters in industrial apparatuses with the aid of radioisotopes. Bazaniak, Z.; Michalik, J.S.; Radwan, M. (Institute of Nuclear Research, Warsaw (Poland)). *Isotopenpraxis;* **14**: No. 5, 168-171(May 1978).

Particle motion in a blast furnace for the production of copper matte was determined with the aid of radioactive tracers. The principle of the method is based on an angular identification of the coordinates of the labelled particle by two moving collimated detectors. The application under industrial conditions does not cause any disturbances in the technological process and does not render more difficult the operation of the investigated apparatus.

54751 Application of radiotracer techniques for the study of particulate matter dynamics in industrial equipment. Bazaniak, Z.; Kruszewska, O.; Masiak, A.; Michalik, J.; Palige, J.; Rafalski, A.; Wisz, Z. (Institute of Nuclear Research, Warsaw (Poland)). *Nukleonika;* **22**: No. 8, 639-663(1977).

A wide use of raw materials and fuels in the solid phase in many industrial manufacturing processes necessitates the development and application of radiotracer techniques for the investigation of particulate matter flow through industrial equipment, which is expected to solve many problems in practice. At the Institute of Nuclear Research, radiotracer techniques for the determination of the motion dynamics parameters of materials fed to ball mills, mixers, rotary kilns or shaft furnaces have been developed. The techniques have been applied to study the processes and the equipment used in the cement industry, iron and steel industry, zinc, lead and copper metallurgy, chemical industry, etc. The developed tech-

niques serve to provide reliable data for modernization, optimzation and designing of processes and equipment.

54752 Feasibility of using the radioactive ionization method for determining the components of a multicomponent gas mixture. Kas'yanova, L.F. pp 110-112 of Mezhvuzovyy sbornik Leningradskogo Elektrotekhnicheskogo Instituta. Leningrad; Leningrad Electrotechnical Inst. (1977). (In Russian)

The radioactive ionization method is proposed for determining the composition of a multicomponent gas mixture in the atmosphere of a hermetically sealed aircraft cabin. The advantages of this method are the possibility of measuring partial pressures, its high sensitivity (sensitivity threshold 1 x 10^{-9} mg/liter), its high accuracy (error within +- 1%), its high speed (10), its high overload capacity, the absence of hysteresis, and the eliminated effect of unmeasurable components. The specific ionization has been calculated for the components of a gas mixture containing O_2, CO_2, H_2, He, $2N_2$, water vapor, and air. A plutonium-238 alpha-emitter serves as the radiation source. An analysis of the calculated data indicates that, disregarding the amounts of H_2 and He, one may treat the air as a mixture of four components: CO_2, O_2, N_2, and water vapor. The feasibility is demonstrated of determining each component by the proposed ionization method with a single measuring channel, using a differential measuring circuit and with the aid of computers.

ISOTOPIC POWER SUPPLIES

54753 (COO—3043-30(Draft)(Vol.1)) **Artificial heart development program. Volume I. System development. Phase III summary report.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). 1977. Contract EY-76-C-02-3043. 418p. Dep. NTIS, PC A18/MF A01.

The report documents efforts and results in the development of the power system portions of a calf implantable model of nuclear-powered artificial heart. The primary objective in developing the implantable model was to solve the packaging problems for total system implantation. The power systems portion is physically that portion of the implantable model between the Pu-238 heat sources and the blood pump ventricles. The work performed had two parallel themes. The first of these was the development of an integrated implantable model for bench and animal experiments plus design effort on a more advanced model. The second was research and development on components of the system done in conjunction with the development of the implantable model and to provide technology for incorporation into advanced models plus support to implantations, at the University of Utah, of the systems blood pumping elements when driven by electric motor. The efforts and results of implantable model development are covered, mainly, in the text of the report. The research and development efforts and results are reported, primarily, in the appendices (Vol. 2).

54754 (COO—3043-30(Draft)(Vol.2)) **Artificial heart development program. Volume II. System support. Phase III summary report. Period covered: July 1, 1973—September 30, 1977.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). 1977. Contract EY-76-C-02-3043. 509p. Dep. NTIS, PC A22/MF A01.

Appendix A covers major activities of the Artificial Heart Development program that supported the design, fabrication, and test of the system demonstration units. Section A.1.0 provides a listing beyond that of the body of the report on the components needed for an implantation. It also presents glove box sterilization calibration results and results of an extensive mock circulation calibration. Section A.2.0 provides detail procedures for assembly, preparing for use, and the use of the system and major components. Section A.3.0 covers the component research and development activities undertaken to improve components of the existing system units and to prepare for a future prototype system. Section A.4.0 provides a listing of the top assembly drawings of the major systems variations fabricated and tested.

54755 (LA—7381-PR) **General-Purpose Heat Source Project, Space Nuclear Safety Program, and Radioisotopic Terrestrial Safety Program. Progress report, May 1978.** Baker, R.D. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 36p. Dep. NTIS, PC A03/MF A01.

The studies related to the use of $^{238}PuO_2$ in radioisotopic power systems carried out for the Advanced Systems and Materials Production Division by the Los Alamos Scientific Laboratory are described. The three programs involved are: (1) general-purpose heat source development; (2) space nuclear safety; and (3) radioisotopic terrestrial safety.

DESIGN AND FABRICATION

54756 (BNWL—1845-38) **Quarterly report on the Strontium Heat Source Development Program, Advanced Systems and Materials Production Division for January—March 1978.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1978. Contract EY-76-C-06-1830. 37p. Dep. NTIS, PC A03/MF A01.

Work has started on a theoretical analysis of the possible consequences of a WESF $^{90}SrF_2$ capsule rupture in an ocean environment. ORNL has begun work on sectioning the capsules from the 12,000 hr compatibility tests with WESF $^{90}SrF_2$. Examination of the Haynes Alloy 25 specimens which were exposed to WESF $^{90}SrF_2$ for 6000 hr has been completed. The 6000-hr specimens suffered much greater attack than the equivalent 1000-hr specimens. The chemical attack mechanisms appeared to vary depending on the exposure temperature, while the addition of Zr + ZrF_4 to the $^{90}SrF_2$ to simulate decay product buildup, produced a marked decrease in metal attack. The preliminary design of the outer capsule for the $^{90}SrF_2$ heat source has been completed. Fabrication of prototype test capsules from AISI 1018 low carbon steel, as a stand-in for thermally aged Hastelloy S, is now underway. The prototype capsules will be subjected to the major $^{90}SrF_2$ heat source qualification test requirements (1000-bar hydrostatic pressure test, impact test, and puncture test) to determine the adequacy of the outer capsule design.

HYDROGEN

PRODUCTION

54757 Hydrogen generator. Kosaka, K.; Ueno, Z.; Ishikura, S.; Chida, A. (to Nissan Motor Co., Ltd.). US Patent 4,088,450. 9 May 1978. Priority date 8 Sep 1975, Japan. 6p.

A plurality of catalysts are arranged in a desirable order based on the temperature gradient existing in the reaction chamber. The operating temperature of the catalyst and the temperature of the portion of the reaction chamber it is in, are matched so as to avoid catalytic degradation and/or catalytic inactivity.

ELECTROLYSIS

REFER ALSO TO CITATION(S) 55332

54758 (EPRI-EM—789) **Economic comparison of hydrogen production using sulfuric acid electrolysis and sulfur cycle water decomposition. Final report.** Farbman, G.H.; Krasicki, B.R.; Hardman, C.C.; Lin, S.S.; Parker, G.H. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.). Jun 1978. 134p. Dep. NTIS, PC A07/MF A01.

An evaluation of the relative economics of hydrogen production using two advanced techniques was performed. The hydrogen production systems considered were the Westinghouse Sulfur Cycle Water Decomposition System and a water electrolysis system employing a sulfuric acid electrolyte. The former is a hybrid system in which hydrogen is produced in an electrolyzer which uses sulfur dioxide to depolarize the anode. The electrolyte is sulfuric acid. Development and demonstration efforts have shown that extremely low cell voltages can be achieved. The second system uses a similar sulfuric acid electrolyte technology in water electrolysis cells. The comparative technoeconomics of hydrogen produced by the hybrid Sulfur Cycle and by water electrolysis using a sulfuric acid electrolyte were determined by assessing the performance and economics of 380 million SCFD plants, each energized by a very high temperature nuclear reactor (VHTR). The evaluation concluded that the overall efficiencies of hydrogen production, for operating parameters that appear reasonable for both systems, are approximately 41% for the sulfuric acid electrolysis and 47% for the hybrid Sulfur Cycle. The economic evaluation of hydrogen production, based on a 1976 cost basis and assuming a developed technology for both hydrogen production systems and the VHTRs, indicated that the hybrid Sulfur Cycle could generate hydrogen for a total cost approximately 6 to 7% less than the cost from the sulfuric acid electrolysis plant.

54759 (SLAC-PUB—2078) **Hydrogen production plants using electrolytic cells with low cost electrodes built into pressure tanks.** Hall, F.F. (Stanford Linear Accelerator Center, CA (USA)). Feb 1978. Contract EY-76-S-03-0326. 33p. (CONF-760304—12). Dep. NTIS, PC A03/MF A01.

From 1. world hydrogen energy conference; Miami Beach, FL, USA (1 Mar 1976).

Electrolytic production method of generating hydrogen gas is briefly reviewed and critical components of electrolytic hydrogen production plants are listed. These components are then discussed

and recommended approaches and arrangements cited. Recommended arrangement would be operated at moderate temperatures and gas pipe line pressures. A hypothetical 150 MW Hydrogen Plant is described, including estimates of cost and performance. Comments are made in regard to several possible generating systems which might be used to power hydrogen production plants. A comprehensive energy policy is appended.

THERMOCHEMICAL PROCESSES

54760 (CONF-780807—8) **Equilibrium effects in high-pressure hydrogen production from thermochemical water-splitting cycles.** Schreiber, J.D.; Dafler, J.R.; Foh, S.E. (Institute of Gas Technology, Chicago, IL (USA)). 1978. Contract EC-77-C-02-4434. 19p. Dep. NTIS, PC A02/MF A01.

From 2. world hydrogen energy conference; Zurich, Switzerland (21 Aug 1978).

When hydrogen comes into widespread use as a supplemental fuel, a chemical feedstock, and a primary, future energy carrier, it must be available at pressures of the order of 50 atmospheres. Existing studies of hydrogen transmission indicate that pipeline pressures of 50 to 100 atmospheres will yield an energy carrier system with better cost-effectiveness than underground transmission of electricity. Because high capacity hydrogen compressors have a low compression ratio, high supply pressures are required. This requirement will affect product separations steps and process heat load-line matching. The hydrogen production steps of a large number of projected water-splitting cycles were classified according to whether the sum of the mole numbers of gaseous products is larger or smaller than the sum of the mole numbers of gaseous reactants. When product mole numbers are larger, the hydrogen production step occurs at relatively high temperatures (about 600°C or higher). When reactant mole numbers are larger, the required temperature is generally low (about 300°C or lower). There were few exceptions, though some water-splitting cycles based on organic chemical reactions fit into a temperature range between these two categories. A group of generalized relationships are presented for hydrogen production steps such that ΔG, the Gibb's free energy change for the reaction, is zero. For equilibria favored by, and not favored by pressure, a series of relationships between the hydrogen mole fraction and product pressure can be defined. The trade-offs between product stream composition and input heat temperature can be assessed. The degree to which feed stream impurities can be tolerated, given fixed operating variables, can also be determined.

54761 **Process for the production of hydrogen from water.** Norman, J.H.; Russell, J.L. Jr.; Stowell, S.A. (to General Atomic Co.). US Patent 4,089,939. 16 May 1978. Filed date 25 Feb 1977. 8p.

Hydrogen is produced from water by reacting I_2, SO_2 and H_2O to make hydrogen iodide and sulfuric acid. SO_2 is present in a substantial molar excess with respect to the available H_2O and I_2 is also present in excess to cause the formation of a lighter sulfuric acid-bearing phase and a heavier hydrogen iodide-bearing phase. The heavier phase is separated from the lighter phase, degassed to remove SO_2 and then treated with additional HI and I_2 to cause the formation of a light immiscible fraction containing sulfuric acid and water which is removed to substantially reduce the sulfur content of the degassed phase. Finally, the hydrogen iodide product is separated and decomposed to produce hydrogen.

54762 **Process for the thermochemical production of hydrogen.** Norman, J.H.; Russell, J.L. Jr.; Porter, J.T. II; McCorkle, K.H.; Roemer, T.S.; Sharp, R. (to General Atomic Co.). US Patent 4,089,940. 16 May 1978. Filed date 8 Apr 1977. 10p.

Hydrogen is thermochemically produced from water in a cycle wherein a first reaction produces hydrogen iodide and H_2SO_4 by the reaction of iodine, sulfur dioxide and water under conditions which cause two distinct aqueous phases to be formed, i.e., a lighter sulfuric acid-bearing phase and a heavier hydrogen iodide-bearing phase. After separation of the two phases, the heavier phase containing most of the hydrogen iodide is treated, e.g., at a high temperature, to decompose the hydrogen iodide and recover hydrogen and iodine. The H_2SO_4 is pyrolyzed to recover sulfur dioxide and produce oxygen.

54763 **Water dissociation by thermochemical cycle: a thermodynamic analyses of its principles and efficiency.** Kaiser, V. *Entropie;* **14**: No. 80, 29-33(1978). (In French).

Since the oil crisis, the production of hydrogen by thermochemical cycles has become the center of public interest. The hydrogen produced directly by nuclear heat is expected to be more flexible energy carrier than the electricity. The thermochemical cycle however brings some fundamental problems concerning the choice of the chemical species to be applied. It is found in fact that the characteristics of the chemical reactions involved have to satisfy some specific limitations. On the other hand a detailed analysis of the theoretical efficiency of such cycles is necessary in order to show the structure of the losses by irreversibility. This analysis made in comparison to the thermomechanical cycle shows that the mixed thermoelectrochemical cycle should have a better chance than the pure thermochemical cycle to reach industrial maturity.

STEAM REFORMER PROCESSES

54764 **Process for production of hydrogen.** Hindin, S.G.; Dettling, J.C. (to Engelhard Minerals and Chemicals Corp.). US Patent 4,091,086. 23 May 1978. Filed date 20 Dec 1976. 6p.

Catalytic compositions particularly useful in the production of hydrogen from methanol, especially by steam reforming, which comprises a mixture of zinc oxide, copper oxide, thorium oxide and aluminum oxide whereby the activity and activity maintenance of the catalytic composition is superior relative to a composition otherwise substantially the same but lacking thoria.

54765 **Steam reformer process for the production of hydrogen.** Villemin, B. (to Azote et Produits Chimiques, Catalysts and Chemicals Europe Societe). US Patent 4,089,941. 16 May 1978. Priority date 22 Oct 1975, France. 6p.

An impregnated nickel catalyst for the steam reforming of gaseous hydrocarbons to produce hydrogen is claimed, comprising a support containing at least 98% of alumina, having the shape of a cylinder containing at least four partitions located in radial planes and in which the porosity ranges between 0.08 and 0.20 cm^3/g, and 4 to 15% of nickel calculated as NiO with respect to the total weight of the catalyst, deposited by impregnation on the support.

STEAM-IRON PROCESS

54766 (CONF-780611—7) **Steam—iron process for hydrogen production.** Tarman, P.B.; Biljetina, R. (Institute of Gas Technology, Chicago, IL (USA)). 1978. 9p. Inst. of Gas Tech., Chicago, IL.

From AIChE symposium; Philadelphia, PA, USA (4 Jun 1978).

In the future, much of our industrial hydrogen will be made from coal. The Steam-Iron process is efficient, producing both high-purity hydrogen and electric power. This process also eliminates the need for an oxygen plant, for acid-gas removal, and for water-gas shift reactors while producing high-purity hydrogen.

54767 **Steam-iron process.** Nakaguchi, S. *Sekiyu Gakkaishi;* **20**: No. 1, 69-73(Jan 1977). (In Japanese).

THE STEAM-IRON PROCESS, developed by the Institute of Gas Technology for producing hydrogen for their Hygas coal gasification process from spent char from that process, is reviewed. Diagrams, graphs, and table.

CHEMISORPTION

REFER ALSO TO CITATION(S) 55500

TRANSPORT

54768 (CONF-780807—1) **Gas distribution equipment in hydrogen service, preliminary findings.** Pangborn, J.B.; Johnson, D.G.; Jasionowski, W.J. (Institute of Gas Technology, Chicago, IL (USA)). 1978. 18p. Inst. of Gas Tech., Chicago, IL.

From 2. world hydrogen energy conference; Zurich, Switzerland (21 Aug 1978).

The Institute of Gas Technology is conducting an experimental program to identify problem areas that could occur with the use of conventional natural gas distribution equipment in hydrogen service. Funded by the U.S. Department of Energy, there are 15 manufacturers and gas distribution companies that are participating by loaning or donating equipment and services. Three operational model test loops have been constructed: a Residential/Commercial loop with smaller sized components, an Industrial loop with larger sized components, and a small test loop for special (created) leakage tests. We are measuring flow rates and energy delivery, and leakage rates, and we will note apparent problems in materials compatibility. Baseline data on natural gas operation have been taken for the Residential/Commercial loop and the Industrial loop, and both of these loops are now operating on pure hydrogen.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 54758

OTHER SYNTHETIC AND NATURAL FUELS

PREPARATION

54769 (DOE/FERC—0008) **National Gas Survey. Synthesized gaseous hydrocarbon fuels.** (Department of Energy, Washington, DC (USA); Federal Energy Regulatory Commission, Washington, DC (USA)). Jun 1978. 307p. Dep. NTIS, PC A14/MF A01.

Report to the Federal Energy Regulatory Commission by the Technical Advisory Task Force.

The supply-Technical Advisory Task Force-Synthesized Gaseous Hydrocarbon Fuels considered coal, hydrocarbon liquids, oil shales, tar sands, and bioconvertible materials as potential feedstocks for gaseous fuels. Current status of process technology for each feedstock was reviewed, economic evaluations including sensitivity analysis were made, and constraints for establishment of a synthesized gaseous hydrocarbon fuels industry considered. Process technology is presently available to manufacture gaseous hydrocarbon fuels from each of the feedstocks. In 1975 there were eleven liquid feedstock SNG plants in the United States having a capacity of 1.1 billion SCFD. There can be no contribution of SNG before 1982 from plants using feedstocks other than liquids because there are no plants in operation or under construction as of 1977. Costs for SNG are higher than current regulated prices for U.S. natural gas. Because of large reserves, coal is a prime feedstock candidate although there are major constraints in the area of coal leases, mining and water permits, and others. Commercial technology is available and several new gasification processes are under development. Oil shale is also a feedstock in large supply and commercial process technology is available. There are siting and permit constraints, and water availability may limit the ultimate size of an oil shale processing industry. Under projected conditions, bioconvertible materials are not expected to support the production of large quantities of pipeline quality gas during the next decade. Production of low or medium Btu gas from municipal solid wastes can be expected to be developed in urban areas in conjunction with savings in disposal costs. In the economic evaluations presented, the most significant factor for liquid feedstock plants is the anticipated cost of feedstock and fuel. The economic viability of plants using other feedstocks is primarily dependent upon capital requirements.

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 54276

54770 (BNL—24427) **Novel interpretations of carbon oxide reduction reactions. I. Over metal oxides.** Sapienza, R.S.; Spaulding, L.D.; Lynch, J.R.; Sansone, M.J. (Brookhaven National Lab., Upton, NY (USA)). May 1978. Contract EY-76-C-02-0016. 11p. (CONF-780902—4). Dep. NTIS, PC A02/MF A01.

From American Chemical Society meeting; Miami, FL, USA (10 Sep 1978).

The mechanism of the Fischer-Tropsch synthesis and the role of the catalyst in that reaction have not yet been satisfactorily explained. It is proposed that the reaction proceeds via the chemisorption of carbon monoxide through the oxygen and that the relative strengths of the metal-oxygen bond will help predict catalyst behavior. It is also proposed that carbon dioxide is reduced in an analogous manner by chemisorption through its oxygens. Although the postulates presented constitute a great oversimplification, the calculations demonstrate a qualitative guideline for the behavior of catalysts in the reaction. (JSR)

54771 (BNL—24477) **FeTi methanation catalyst.** Lynch, J.R.; Spaulding, L.D.; Sapienza, R.S. (Brookhaven National Lab., Upton, NY (USA)). Jun 1978. Contract EY-76-C-02-0016. 12p. (CONF-780902—1). Dep. NTIS, PC A02/MF A01.

From American Chemical Society meeting; Miami, FL, USA (10 Sep 1978).

The intermetallic compound FeTi was found to catalyze the reduction of CO and CO_2 to methane by hydrogen. CO reduction yielded traces of ethane as did CO_2, in addition, CO_2 reduction yielded small amounts of methanol. The appearance of CH_4 was linear with time for both CO and CO_2 and the rate of CO_2 reduction was faster than that observed for CO. The product distribution and rate data lend support to and will be discussed in terms of the newly proposed oxide theory for Fischer-Tropsch and related synthesis.

54772 (FE—2416-29) **Conceptual designs of commercial plants: coal to methanol and methanol to gasoline. Quarterly technical progress report, January 28, 1978—April 28, 1978.** (Badger Plants, Inc., Cambridge, MA (USA)). 23 Jun 1978. Contract EX-76-C-01-2416. 10p. Dep. NTIS, PC A02/MF A01.

The status of the work in the following areas is summarized: design of coal gasifier and process designs for three coal conversion processing schemes each integrating the Mobil M-Gasoline process. Process design of the scheme producing gasoline plus by-product LPG and high Btu gas has developed to the point that it is possible to integrate and establish a coal-to-gasoline complex within the boundaries of the coal-to-methanol commercial plant. (JSR)

54773 (FE—2467-7) **Transition metal-graphite catalysts for production of light hydrocarbons from synthesis gas. Quarterly report, February 1, 1978—April 30, 1978.** Rosynek, M.P. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). May 1978. Contract EX-76-C-01-2467. 26p. Dep. NTIS, PC A03/MF A01.

Cobalt-graphite intercalates, when used as catalysts for the hydrogenation of carbon monoxide at one atmosphere pressure, exhibit a markedly different effect of reaction temperature on product distribution in the range 200 to 300°C than does a conventional kieselguhr-supported cobalt catalyst under the same conditions. In the latter case, the percentage of all reacted CO involved in methane formation increased from 27% at 200° to 87% at 300°C, while the percentage yielding C_3^+ hydrocarbons decreased proportionately from 69% to 7%. Over cobalt-graphite, on the other hand, methane accounted for a virtually constant 35% of all reacted CO throughout the 200 to 300°C range, while the $C_2 + C_3$ olefin/paraffin fraction increased slightly from 31% at 200° to 41% at 300°, and C_4^+ hydrocarbons only decreased from 30% to 20% of all converted CO at the same temperatures. The results suggest that interlayer penetration of the graphite intercalate lattice by H_2/CO reactant may be the rate-limiting step of the reaction. Poisoning studies utilizing hydrogen sulfide indicated that only 0.6 to 0.7% of all intercalated cobalt atoms are accessible as catalytically active sites.

54774 (FE—2490-6) **Fluid bed process studies on selective conversion of methanol to high octane gasoline. Quarterly report No. 2, January—March 1977.** Lee, W. (Mobil Research and Development Corp., Paulsboro, NJ (USA)). Apr 1977. Contract EX-76-C-01-2490. 43p. Dep. NTIS, PC A03/MF A01.

Flow studies continued in the flow demonstration unit with non-reacting gases. Major process variable effects on fluidization have been determined for superficial gas velocities of 0.5 to 2.0 ft/sec. A mathematical model for catalyst entrainment rate has also been developed. Special capacitance probe and associated electronic instruments have been constructed for bubble measurement experiment in the flow demonstration unit. Several different design concepts for feed distributor have been developed. The effect of feed distributor design on gas, solid, and liquid mixing rate is being studied with the instruments developed. The design and detailed engineering of the fluid bed methanol conversion pilot plant have been completed. Unit construction progressed smoothly on schedule. Completed to date include fabrication of all tankage, installation of process vessels and associated pipes, construction of 40' high supporting steel structure with a 10' x 20' modular enclosure to house the control panel and GC system.

54775 (FE—2490-9) **Fluid bed process studies on selective conversion of methanol to high octane gasoline. Quarterly report No. 3, April—June 1977.** Lee, W. (Mobil Research and Development Corp., Paulsboro, NJ (USA)). Jul 1977. Contract EX-76-C-01-2490. 44p. Dep. NTIS, PC A03/MF A01.

Several different designs of feed distributor have been evaluated with non-reacting gases. The capacitance probe, electronic counter, and cross correlator were successively utilized for the experiment. A five-prong nozzle with liquid-vapor atomizers covered with a perforated grid was found to be most satisfactory with respect to even distribution of feed over the reactor cross-sectional area, maximum catalyst recirculation, and rapid mixing of hot catalyst and feed. Capacitance probes for high temperature operation in the methanol-to-gasoline unit have been designed using Pt/Rh wires and ceramic insulation. Construction of the 4 B/D fluid bed methanol-to-gasoline pilot plant has been completed on schedule. The original design was improved significantly during the engineering and construction period, as more insights were gained from the flow studies and process analysis. Major accomplishments completed in this report period include reactor-regenerator-hopper installation, instrumentation, piping, and electrical works. Debugging and shakedown operations are being carried out now.

54776 (FE—2490-12) **Fluid bed process studies on selective conversion of methanol to high octane gasoline. Annual report, October 1976—September 1977.** Lee, W. (Mobil Research and Development Corp., Paulsboro, NJ (USA)). Oct 1977. Contract EX-76-C-01-2490. 164p. Dep. NTIS, PC A08/MF A01.

Construction of the 4 B/D fluid bed methanol-to-gasoline pilot plant was completed on schedule. The original design was improved significantly as a result of flow characterization studies conducted in glass models. Gas velocity effects on the catalyst entrainment rate, bed density, and reactor inventory determined in the glass models were used for the pilot plant design calculations.

Capacitance probe techniques to measure the quality of fluidization were developed and applied to the design and evaluation of feed distributors and baffles. These were incorporated into the 4 B/D pilot plant, which features a 4" ID x 25' high dense fluid bed reactor with a 2½" ID external catalyst recirculation line integrated with a 10" ID x 32" high regenerator. The viability of the fluid bed methanol-to-gasoline process was demonstrated in the 4 B/D pilot plant. Complete methanol conversion and extremely smooth operations were accomplished. The reactor temperature profile was almost uniform over the entire 25' length. Catalyst activity in the reactor was maintained near the target level by make-up catalyst and intermittent regenerations. Product selectivity and quality were comparable to the previous bench unit results.

54777 Conversion of synthesis gas to hydrocarbon mixtures. Chang, C.D.; Lang, W.H.; Silvestri, A.J.; Smith, R.L. (to Mobil Oil Corp.). US Patent 4,096,163. 20 Jun 1978. Filed date 8 Oct 1976. 14p.

Synthesis gas is contacted with an intimate mixture of a carbon monoxide hydrogen reduction catalyst, comprising a methanol synthesis catalyst in combination with a selective class of acidic crystalline aluminosilicate having a silica/alumina ratio greater than 12, a pore dimension greater than about 5 Angstroms to produce hydrocarbon mixtures useful in the manufacture of heating fuels, gasoline, aromatic hydrocarbons, and chemicals intermediates.

54778 Integrated catalytic gasification process. Koh, K.K.; Nahas, N.C.; Pennington, R.E.; Vernon, L.W. (to Exxon Research and Engineering Co.). US Patent 4,094,650. 13 Jun 1978. Filed date 11 Nov 1976. 22p.

Methane and carbon dioxide are produced by reacting steam with a carbonaceous feed material at a reaction temperature between about 1000°F and about 1500°F and a reaction pressure in excess of about 100 psia in the presence of a carbon-alkali metal catalyst and equilibrium quantities of added hydrogen and carbon monoxide. The raw product gas withdrawn from the reaction zone is treated for removal of the carbon dioxide, product methane is recovered from the treated gas, and the remaining hydrogen and carbon monoxide can be recycled to supply the added hydrogen and carbon monoxide needed in the reaction zone.

54779 Process for producing methane rich gas. Goudal, P. (to Electricite de France (Service National)). US Patent 4,092,129. 30 May 1978. Priority date 26 Aug 1975, France. 8p.

Gas rich in methane is produced by employing an electrolytic cell whereby oxygen is produced at the anode and hydrogen is produced at the cathode thereof. The cell includes a post-anodic compartment containing coal and/or lignite for reacting with the oxygen to produce CO. The CO in turn is reacted with the hydrogen from the cathode to produce the gas rich in methane.

54780 Production of a gas rich in methane. Watson, A.; Hohmann, P.; Schmid, H.; Schneider, H. (to Linde AG). US Patent 4,091,008. 23 May 1978. Priority date 23 Aug 1974, German, Federal Republic of (F.R. Germany). 6p.

In a process for the production of a methane-rich gas from a feed gas of hydrogen and carbon oxides, wherein the feed gas, after preliminary purification thereof, is warmed, then subjected to a multistage, catalytic methanization, and thereupon is subjected to a CO_2 separation step, the improvement which comprises conducting the preliminary purification step as well as at least a portion of the CO_2 separation step by a physical scrubbing process; and employing the same scrubbing agent in both of said physical scrubbing steps.

54781 Kinetics of CO hydrogenation of Ni (100). Goodman, D.W.; Kelley, R.D.; Madey, T.E.; Yates, J.T. Jr. (National Bureau of Standards, Washington, DC). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 446-450(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

An ultrahigh vacuum system and an Auger electron spectrometer were used to examine the effect of surface structure and chemical composition on the kinetics of the catalytic methanation reaction $3H_2 + CO = CH_4 + H_2O$. Results show that the kinetics of CH_4 production over initially clean Ni(100) are in good agreement with those for polycrystalline Ni foil. Traces of surface impurities such as Fe act as poisons. It is concluded that well-characterized single crystal samples can serve as models of practical, working catalysts. 3 figs.

54782 Catalytic hydrogenation of carbon monoxide on nickel foils and powders. Polizzotti, R.S.; Schwarz, J.A.; Kugler, E.L. (Exxon Research and Engineering Co., Linden, NJ). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 451-461(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

It is shown that the activation energy for the hydrogenation of carbon monoxide to methane on Ni is a function of the temperature and H_2/CO ratio. The observed behavior has been described by a sample model which takes into account the dependence of the hydrogen and carbon monoxide surface concentrations on temperature and pressure. This model suggests that gas phase hydrogenation of a surface adsorbed complex is necessary to account for the observed kinetics. 9 figs.

54783 Hydrocarbon synthesis using catalysts formed by intermetallic compound decomposition. Elattar, A.; Wallace, W.E.; Craig, R.S. (Univ. of Pittsburgh). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 464-468(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Results clearly show that active catalysts can be formed by the decomposition of intermetallic compounds. The RNi_5 compounds, which under reaction conditions decompose into Ni/R_2O_3, exhibit kinetic parameters which are strong functions of the nature of R. Why this is so remains to be clarified. The two actinide intermetallics, $ThNi_5$ and UNi_5, decompose to give Ni/ThO_2 and Ni/UO_2. The former is very active and is relatively resistant to H_2S poisoning, whereas the latter is only weakly active and is easily poisoned by H_2S. The differing behavior of these two materials has been studied and partially elucidated by Auger spectroscopy and characteristic energy loss spectroscopy. Ni in Ni/UO_2 becomes heavily overlaid with graphite whereas with thoria as the substrate this does not happen. The plasmon oscillation behavior of the substrates, which is now under study, exhibits sufficiently different behavior from catalyst-to-catalyst as to suggest substantially different electronic nature of the oxide substrate. Perhaps this underlies the variation in observed kinetic parameters of the several supported Ni catalysts.

54784 Carbon monoxide hydrogenation over ruthenium zeolites. Jacobs, P.A.; Nijs, H.H.; Verdonck, J.J.; Uytterhoeven, J.B. (Katholieke Universiteit, Louvain, Belgium). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 469-474(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Ru zeolites are active and stable methanation catalysts. Under Fischer—Tropsch conditions they show a narrow product distribution. Further work is needed to assign this to a possible effect exerted by the zeolite cages. When the size of the Ru particles enclosed in the zeolite cages is increased, a lower methanation activity is found and a higher amount of C_2 and C_3 products are formed under Fischer—Tropsch conditions. This effect has not been reported until now on other supports. The less acidic zeolites act as promoters of the CO hydrogenation: under methanation conditions the activity is increased; under Fischer—Tropsch conditions, the selectivity is shifted toward higher hydrocarbons. This is explained by the particular zeolite property that electron deficient metal agglomerates seem to be formed on the acidic zeolites. With respect to kinetic behavior, relative activity of different metals, influence of reaction temperature on product distribution, the zeolite behaves in the same way a conventional alumina support. 4 figs., 4 tables.

54785 Infrared and kinetic studies of hydrocarbon synthesis over a Ru catalyst. Ekerdt, J.G.; Bell, J.T. (Univ. of California, Berkeley). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 475-481(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

The $CO + H_2$ reaction was studied. Infrared spectra indicate that under reaction conditions, the catalyst surface is saturated with CO. Conversion of CO to CH_4 depends on the H_2/CO ratio. The Ru surface is covered by CO, and in order for CH_4 to form, H_2 must compete for the remaining unoccupied sites. CH_4 and C_2H_6 probably arises through a common precursor, e.g., an Ru-CH groups, and C_2H_6 might occur through dimerization of Ru-CH groups. 6 figs. (DLC)

54786 In situ infrared study of CO hydrogenation over supported ruthenium. King, D.L. (Amoco Oil Co., Naperville, IL). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 482-494(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Both Ru/Al_2O_3 and Ru/SiO_2 catalysts were studied; most of the work was done on the latter. The major surface species during the reaction are adsorbed CO and CH_2 groups. All CO molecules are not equal in reactivity; the weakly held CO is more reactive. The CH_2 groups appear to occupy only a small fraction of the surface. The deactivating species probably are carbon groups with little or no hydrogen. There is no evidence for an enolic intermediator for the formyl complex. Results are consistent with rapid hydrogenation and growth of chains by CH_2 insertion. 9 figs. (DLC)

54787 CO hydrogenation over well-characterized Ru—Fe alloys. Vannice, M.A. (Pennsylvania State Univ., University Park); Lam,

Y.L.; Garten, R.L. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 495-501(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

A study was made of the catalytic behavior of silica-supported Ru—Fe alloys which were characterized by chemisorption, x-ray diffraction, and Moessbauer spectroscopy. Moessbauer results are consistent with Ru—Fe biometallic clusters, although the isomer shift for Fe at the surface is different from that inside the clusters. At Ru/Fe ratios between 0.5 and 2, methane production is reduced and olefin formation is enhanced. (DLC)

54788 Cobalt-based catalysts for the production of C_2—C_4 hydrocarbons from Syn-gas. Dent, A.L.; Lin, M. (Carnegie-Mellon Univ., Pittsburgh). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 502-512(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Studies were conducted to develop more selective Fischer—Tropsch catalysts for making C_2-C_4 hydrocarbons from Syngas. The Cr- and Zr-doped catalysts were the most active for CO conversion but also the most selective for methane. For production of C_2-C_4 olefins, the 100 Co:50 Mn:400 Al_2O_3:5.5 K_2O catalysts appears to be best. 2 tables, 6 figs. (DLC)

54789 Catalytic synthesis of light olefinic hydrocarbons from CO and H_2 over some iron catalysts. Yang, C.H.; Oblad, A.G. (Univ. of Utah, Salt Lake City). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 513-520(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Iron properly promoted has been found to be an effective catalyst for the conversion of H_2/CO to light olefinic hydrocarbons. At the same time results have been obtained which indicate directions for controlling to some extent the C_1 production and to a considerable extent the CO_2 and oxygenated compound production. The most promising promoter for iron appears to be calcium and manganese. These findings plus the well known effects of potassium as promoter, indicate directions for synthesis of optimum catalysts for light hydrocarbon production particularly olefins. The most promising results show that in excess of 50% yields of C_2-C_4 (of CO converted) having olefin contents as high as 75% or higher are achievable. 6 figs.

54790 Hydrogenation of CO and CO_2 on clean rhodium and iron foils: correlations of reactivities and surface compositions. Dwyer, D.; Yoshida, K.; Somorjai, G.A. (Univ. of California, Berkeley). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 521-537(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Thermodynamic considerations and experiment indicate that using CO—H_2, one should be able to produce selectively a very broad range of hydrocarbons, including alcohols, olefins, acids, and aromatics. This investigation correlates the reaction rates and product distributions with catalyst composition and structure. Hydrogenation of CO and CO_2 over rhodium was studied and compared with that over iron. The mechanism of the methanation reaction is discussed. 7 tables, 11 figs. (DLC)

54791 Kinetics of CO + H_2 reaction over Co—Cu—Al_2O_3 catalyst. Yang, C.H.; Massoth, F.E.; Oblad, A.G. (Univ. of Utah, Salt Lake City). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 538-544(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Since hydrocarbon selectivities of this catalyst system are very different (higher C_2-C_4, lower CH_4 and CH_3OH) from those of Fischer—Tropsch and methanation catalysts, this system was studied in detail. Effects of process variables on CO conversion and hydrocarbon selectivity were studied. Rate constants were determined. Results agree with the contention that H_2O formation is the primary reaction and that CO_2 forms by a secondary reaction. Since a C_2-C_4 fraction of 51% was obtained in one run, the catalyst is probably close to maximum in C_2-C_4 selectivity. Neither K_2O nor Na_2O is effective as a promoter. 5 figs., 2 tables.

54792 Fischer—Tropsch studies in a bench-scale tube wall reactor using magnetite, Raney iron, and taconite catalysts. Haynes, W.P.; Baird, M.J.; Schehl, R.R.; Zarochak, M.F. (Pittsburgh Energy Research Center). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 559-572(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Flame-sprayed Raney iron after induction is the most active catalyst of the group. The flame-sprayed taconite after induction has very good temporal stability and an acceptable activity. High pressure favors production of oxygenates. Selectivity to gas products is very high without alkali impregnation and lower H_2/CO feed rates. Low temperatures favor selectivity toward liquid production.

54793 High quality transportation fuels from Co—H_2: a competitive option. Harney, B.M.; Mills, G.A.; Joseph, L.M. (Department of Energy, Washington, DC). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 573-577(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Processes for transportation fuels based on the conversion of coal-derived CO-H_2 have advantages of: operation at moderate temperatures and pressures, high reliability of operation, a known environmental impact and the production of a high quality product. A significant thermal penalty is endured which accounts substantially for the high product cost. A process for producing gasoline via synthesis gas utilizing the Mobil route appears competitive with the catalytic H-coal hydroliquefaction process.

54794 Chain growth in the Fischer—Tropsch synthesis: a computer simulation of a catalytic process. Anderson, R.B.; Chan, Y. (McMaster Univ., Hamilton, Ont.). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 578-586(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

Complicated grain growth schemes involving a third constant for producing ethyl-substituted species, are proposed and tested. Predicted and experimental ratios of branched to normal molecules are compared. For Co, all schemes predict yields of dimethyl species that are often too large by factors of 2 to 4; the discrepancy is worse for Fe and Ni. 7 tables. (DLC)

54795 American Chemical Society conference. Gould, J.R. (ed.). Washington, DC; American Chemical Society (1978). 403p.

Forty-eight papers and abstracts are included in the four symposia on relations between mass spectrometry and pyrolysis, photolysis, and radiolysis of organic compounds (6 papers); advances in Fischer—Tropsch chemistry (20 papers); chemistry of oil recovery (10 papers); and recent advances in the production and utilization of light olefins (12 papers). Separate abstracts were prepared for 25 of the papers. (DLC)

54796 Methanation catalyst and process of use. Parthasarathy, R. (to W. R. Grace and Co.). US Patent 3,933,883. 20 Jan 1976. vp.

W. R. Grace and Co. has developed an improved methanation catalyst for fluidized-bed operation that requires less nickel and cobalt, exhibits a high methanation reaction activity, and offers good stability. The improved catalyst is an alumina-supported nickel-cobalt catalyst having a nickel-cobalt mole ratio of 1—1.5, surface area of 100—200 cu m/g, an average pore diameter of 100—115 A, and a pore volume of 0.25—0.7 cc/g. The catalyst permits methanation at a temperature of 248°—1202—F (120°—650°C) and a pressure of 100—2000 psig.

PREPARATION FROM WASTES OR BIOMASS

54797 (COO—2900-13) **Fast production of methane by anaerobic digestion. Progress report, January 7, 1978—February 6, 1978.** Finney, C.D.; Evans, R.S. II; Finney, K.A. (Natural Dynamics, Des Moines, IA (USA)). Feb 1978. Contract EY-76-C-02-2900. 40p. Dep. NTIS, PC A03/MF A01.

The sensitivity of the gas-producing methanogens to environmental change is the rationale behind the development of a procedure for determining relative rate coefficients wherein thermodynamic variables such as temperature, pressure, ionic strength, and loading are maintained constant. Preliminary data on the rate of disappearance of volatile acids shows that production of gases is strongly dependent upon mixing speed in the 50 to 150 rpm regime. More detailed experiments are being pursued to refine, amplify, and extend this initial result. Comprehensive tables on the comparative daily performance of the digesting systems are also presented.

54798 (NP—23202) **Treatment and utilization of landfill gas. Mountain View Project Feasibility Study.** Blanchet, M.J. (Pacific Gas and Electric Co., San Francisco, CA (USA)). 1977. 122p. Solid Waste Information, EPA, Cincinnati, OH.

The production, treating, transportation, and utilization of landfill gas are discussed in this report. The economics of these steps are also covered. The analysis is performed from the perspective of the Pacific Gas and Electric Company, one of the partners in the Mountain View Landfill Gas Recovery Demonstration Project, scheduled to be operating by early 1977. The U.S. Environmental Protection Agency is supporting the City of Mountain View in this demonstration under Grant No. S-803396-01.

54799 Apparatus and method for producing combustible gases from biomass material. Caughey, R.A. (to Forest Fuels, Inc.). US Patent 4,095,958. 20 Jun 1978. Filed date 21 Jun 1977. 6p.

A reactor is claimed wherein a biomass is moved progressively downwardly along the upwardly facing side of an inclined grate supported with an enclosure comprising a retort, the rear and front walls of which provide, in conjunction with the grate, a plenum chamber at the downwardly facing side of the grate and a mixing chamber at the upwardly facing side of the grate. The said structure provides for converting the biomass by a process of destructive distillation to CO and ash characterized in that the grate is maintained at a temperature below the fusion temperature of the ash to prevent slagging of the ash by the expedient of supplying an excess of primary air to the plenum chamber at the lower end of the grate so that it flows upwardly along the downwardly facing side. The surplus is discharged at the top, providing the grate with a plurality of relatively small openings distributed throughout its length and breadth and providing fins at the downwardly facing side of the grate perpndicular to the plane of the underside of the grate which extend into the flowpath of the primary air. The rear wall of the retort is spaced rearwardly from and parallel to the downwardly facing side of the grate and forms therewith a manifold for containing the primary air as it flows upwardly therein, a force draft fan provides for delivering the primary air to the lower end of the manifold chamber and a damper at each end of the manifold chamber provides for controlling the flow of primary air.

54800 Method and apparatus for producing gas from solid municipal waste. Mansfield, V. (to Mansfield Carbon Products, Inc.). US Patent 4,091,748. 30 May 1978. Filed date 3 Dec 1976. 4p.

Solid municipal waste refuse is pre-treated by partial burning in a moving grate hot carbonizer furnace and then further burned on a reciprocating step-grate stoker in the same furnace chamber. Limited amounts of air are fed to the waste through the grates to avoid the formation of hot spots in the burning material, thereby preventing the formation of clinkers and restricting the burning of volatile matter in the refuse. Hot low-Btu gas exhausted from the furnace chamber is burned in a boiler.

54801 Apparatus for producing methane gas by processing waste materials. Switzgable, H. (to Alpha Systems Corp.). US Patent 4,090,940. 23 May 1978. Filed date 23 Jan 1976. 10p.

Apparatus are claimed for producing methane and other products by processing a slurry of biodegradable waste materials, including two tanks containing waste material which are connected to allow fluid flow communication between slurry in each tank. Each tank is airtight with respect to the ambient, one of said tanks containing a cathode and the other tank containing an anode to aid in the growth of methane producing bacteria. The tanks are provided with movable hoods for collecting gas.

54802 Energy for agriculture and the gasification of crop residues. Horsfield, B.; Williams, R.O. (Univ. of California, Davis). *Energy Sources;* **3**: No. 3/4, 277-292(1978).

Although agriculture uses large amounts of energy for growing and processing foods, it also generates even larger amounts of unused energy in the form of crop residues. For the successful utilization of this energy source at the farm or food-processing level, a simple, low-cost method of converting residue energy to heat or shaft horsepower is needed. Such a method is gasification. The theory of gasification is reviewed and its historical application to crop residue is presented. Several potential applications are discussed.

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 54626

54803 (BNL—24428) **Novel interpretations of carbon oxide reduction reactions. II. Over metal oxides.** Sapienza, R.S.; Spaulding, L.D.; Lynch, J.R.; Sansone, M.J. (Brookhaven National Lab., Upton, NY (USA)). May 1978. Contract EY-76-C-02-0016. 9p. (CONF-780902—3). Dep. NTIS, PC A02/MF A01.

From American Chemical Society meeting; Miami, FL, USA (10 Sep 1978).

A mechanism is proposed for the formation of methanol and other oxygenated organic products from carbon monoxide and hydrogen over metal oxide catalysts. These products are formed via the associative adsorption of carbon monoxide on the oxygen of the metal oxide surface, followed by reduction with metal activated hydrogen. Carbon dioxide is dissociated to chemisorbed CO and O. This explains why over-reduction of methanol catalysts results in the formation of hydrocarbons rather than methanol. The mechanism of methanol formation with combined heterogeneous nickel boride and homogeneous molybdenum hexacarbonyl is postulated. (JSR)

54804 Process for producing ethanol, acetic acid and/or acetaldehyde, from synthesis gas. Ellgen, P.C.; Bhasin, M.M. (to Union Carbide Corp.). US Patent 4,096,164. 20 Jun 1978. Filed date 30 Aug 1976. 10p.

A process is claimed for selectively preparing a mixture of two-carbon atom oxygenated hydrocarbons in which ethanol is the major component which comprises continuously contacting a reaction mixture containing hydrogen and carbon monoxide with a solid catalyst comprising rhodium in combination with molybdenum and/or tungsten at reaction conditions correlated so as to favor the formation of such two-carbon atom products, namely, acetic acid, acetaldehyde, and/or ethanol.

54805 Selective formation of methanol from synthesis gas over palladium catalysts. Poutsma, M.L.; Elek, L.F.; Ibarbia, P.A.; Risch, A.P.; Rabo, J.A. (Union Carbide Corp., Tarrytown, NY). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 587-594(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

It is reported that hydrogenation of CO over supported Pd catalysts produces methanol in high selectivity within the temperature-pressure regime where CH_3OH formation is thermodynamically allowed. The same behavior was found for Pt and Ir as well, but at lower rates. The mechanism of CH_3OH formation on Pd is discussed. 3 tables, 33 references. (DLC)

54806 Catalytic synthesis of methanol from CO/H_2. I. Phase composition, electronic properties, and activity of the $Cu/ZnO/M_2O_3$ catalysts. Herman, R.G. (Lehigh Univ., Bethlehem, PA); Klier, K.; Simmons, G.W.; Finn, B.P.; Bulko, J.B.; Kobylinski, T.P. *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 595-615(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

The catalytic activity of the low pressure $Cu/ZnO/Al_2O_3$ or Cr_2O_3 catalysts for methanol synthesis resides in the Cu/ZnO system. No special pore distribution or presence of crystalline phases such as spinels is necessary for selectivity to methanol. The Cu/ZnO system stabilizes a black substance which has been identified as a Cu/sup I/ solution in ZnO. A synthesis mechanism is proposed whereby the Cu/sup I/ centers chemisorb and activate carbon monoxide and the ZnO surface activates hydrogen. Catalyst deactivation in the CO/H_2 mixture is explained as the reduction of Cu/sup I/ to inactive copper metal, and the promotion effect of O_2, H_2O, and CO_2 as a maintenance of oxidation potential high enough to keep the copper in the active Cu/sup I/ state. Poisoning by hydrogen sulfide and HCl is attributed to irreversible heteropolar chemisorption of H_2S and HCl with blocking of the Cu/sup I/ centers by the SH^- and Cl^- groups. 4 tables, 11 figs., 58 references.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 55395

54807 (COO—4147-3) **Bioconversion of plant biomass to ethanol. Third quarterly and bimonthly report, July 1—September 30, 1977.** Brooks, R.E.; Bellamy, W.D.; Su, T.M. (General Electric Co., Schenectady, NY (USA). Research and Development Center). Oct 1977. Contract EG-77-C-02-4147. 36p. Dep. NTIS, PC A03/MF A01.

The studies of biological delignification have focused on the adaptation of the lignocellulosic thermophilic mold Chrysosporium pruinosum to growth on maple wood fibers. The addition of trace elements and thiamine hydrochloride to the C. pruinosum growth medium has been found to stimulate culture growth by a factor of about two. The nutritional salt tolerances of C. pruinosum have been determined. Nutrient concentrations below of about 2.5 times that required to support C. pruinosum growth have no significant deleterious inhibitory effects. Work on the design and construction of a bench-top high solids biological delignification bioreactor has been initiated. The mixed culture microbiological studies have focused mainly on nutritional growth requirements and rates of cellulose digestion and ethanol production. In small test tube mixed culture (sporocytophaga (US) + thermophilic bacillus (NW)) fermentations, the rate of cellulose degradation was found to proceed at a very high volumetric efficiency, 2.4 g/l-hr. The yield of ethanol from the mixed culture fermentation of cellulose varied between 24 and 50% of theoretical. The higher yields were obtained in the presence of insoluble calcium carbonate added to retard the rate of pH decline and to increase the CO_2 tension. Bench-top fermentations at the 1 liter scale have been performed to verify, under controlled pH, agitation, and dissolved oxygen conditions, the results achieved in small scale test tube experiments. The specific growth rate of thermophilic bacillus NW on glucose was calculated to be 0.59 hr^{-1}. In mixed culture fermentations of amorphous and microcrystalline cellulose the specific rate of substrate depletion was calculated to be

0.087 hr^{-1} and 0.0346 hr^{-1}, respectively. Ethanol production in these fermentor runs was slower than the rates of acetic acid production. In the fermentation of microcrystalline cellulose, 2,3 butanediol was also produced.

54808 (TID—28414) **Fuels from sugar crops. First quarterly report.** Lipinsky, E.S.; Kresovich, S.; McClure, T.A.; Lawhon, W.T. (Battelle Columbus Labs., OH (USA)). 29 Jul 1977. Contract EG-77-C-02-4147. 153p. Dep. NTIS, PC A08/MF A01.

The primary objectives of the present study are to evaluate the feasibility of reducing the costs of fermentable sugars derived from sugar crops and to increase their availability for the following methods: (1) close space of sugar crops; (2) production of sweet sorghum varieties high in fermentable sugar, regardless of table sugar prospects; and (3) harvesting and processing of the entire aerial part of sugarcane and/or sweet sorghum. Close row spacing of sugarcane is under investigation in Florida and Louisiana. Preliminary research indicates that the cost of this sugarcane may be approximately 30 percent less than that of conventional cane. In addition, tests have shown that the close-spaced sugarcane has virtually the same content of fermentable sugars as does conventional cane. Close-spacing of sweet sorghum is being studied in Louisiana and Texas with record yields being obtained in field tests. The material and energy balances of a facility to process 8,200 metric tons/day of sugarcane into ethanol, stillage, and electricity leads to the preliminary conclusion that more than enough biomass will be available to make the facility energy self-sufficient. The mechanical difficulties of a novel rind/pith separation system have been corrected and an economic analysis of the systems is being made. (JSR)

54809 **Preparation of liquid fuel and nutrients from solid municipal waste.** Lang, J.L. US Patent 4,094,740. 13 Jun 1978. Filed date 27 Sep 1974. 4p.

The organic portion of solid municipal waste is converted into a liquid fuel suitable for use in internal- and external-combustion engines, a residue suitable for plant or animal nutrients and purified water by the process which comprises separation of the waste into a hydrolyzable fraction, hydrolysis of said fraction, saccharification, fermentation, distillation, and concentration.

54810 **Preparation of liquid fuel and nutrients from municipal waste water.** Lang, J.L. US Patent 4,093,516. 6 Jun 1978. Filed date 27 Sep 1974. 6p.

The organic portions of the impurities in municipal waste are converted into a liquid fuel suitable for use in internal- and external-combustion engines, a residue suitable for animal feed supplement and purified water by the process which comprises the steps of: partial concentration, saccharification, fermentation and distillation.

PROPERTIES

54811 **Decomposition of ammonia on ruthenium—yttrium catalysts supported on aluminum oxide.** Sokol'skii, D.V.; Kuzora, T.V. (Inst. of Organic Catalysis and Electrochemistry, Alma-Ata, USSR). *Dokl. Chem. (Engl. Transl.);* **237**: No. 1-3, 696-698(Nov 1977).

Translated from Dokl. Akad. Nauk SSSR; 237: No. 3, 616-618(Nov 1977).

The effect of the Ru—Y ratio on the catalytic effects of Ru in the decomposition of ammonia was studied. The decomposition was carried out at 300 to 500°C in a flow system. The tabulated results show that Y supported on aluminum oxide has very little catalytic action. The addition of inactive Y to Ru increases the activity of the supported Ru catalyst. The Ru catalyst containing 10 wt. % Y shows the greatest activity. Addition of more than 20 wt. % Y reduces the activity. The rate constants for the ammonia decomposition were calculated. (JSR)

54812 **Kinetics of ammonia oxidation.** Anokhin, V.N.; Babankov, V.P.; Kosyak, A.A. *J. Appl. Chem. USSR (Engl. Transl.);* **50**: No. 3, 463-467(Mar 1977).

Translated from Zh. Prikl. Khim.; 50: No. 3, 477-482(Mar 1977).

The chemical kinetics of heterogeneous oxidation of ammonia are explained from the standpoint of the adsorption potential theory. A potential diagram is included reflecting the distribution of the reactants over a catalyst surface during overall oxidation reactions. The diagram is used in an examination of the elementary steps of oxygen-ammonia interactions. Expressions representing these reactions are given and it is noted that the experimental data are in agreement with the calculated results (JRD)

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 54808, 55389

54813 (AD-A—050423) **Estimating effective heating value of wood or bark fuels at various moisture contents. General technial report.** Ince, P.J. (Forest Products Lab., Madison, WI (USA)). 1977. 12p. (FSGTR-FPL—13). NTIS PC A02/MF A01.

The procedure described here to estimate effective heating value of wood or bark fuel is based on calculating the difference between theoretical maximum thermal value (higher heating value) of wood materials and estimates of unavoidable heat losses of furnace combustion. Unavoidable heat losses of furnace combustion are principally caused by woodborne moisture and hydrogen and any excesses of air admitted to the furnace.

54814 **Waste processing system.** Holmes, W.H. (to Holmes Bros., Inc.). US Patent 4,095,956. 20 Jun 1978. Filed date 7 Jul 1976. 4p.

A waste to fuel processing system is claimed wherein solid municipal waste is converted to usable industrial fuel. The waste is deposited in a relatively large "pick" or receiving pit having mechanical means for removing very bulky, outsized material. The remaining waste is delivered by conveyor to a first rotating trommel having holes that are at least one foot in diameter. Combustible material over a foot in diameter which is rejected by the first trommel is reduced by coarse shredding and remixed with the other combustibles at the packaging apparatus. Material that passes through the holes of the trommel is delivered by conveyor to a second rotating trommel having holes that do not exceed 2.5 inches in diameter. In the second trommel, frangible material along with small stones and dirt drops through the holes and the remaining waste is delivered by conveyor to packaging apparatus, such as a baler or compactor, for conditioning it for use as fuel.

54815 **Crop residues as energy sources: assessing the cost and energy feasibility of direct firing.** Starr, P.J.; Finn-Carlson, D.W.; Nachtsheim, C.J. (Univ. of Minnesota, Minneapolis). *Energy Sources;* 3: No. 3/4, 353-373(1978).

Crop residue is a renewable resource that could supply various energy products to an agricultural region. The feasibility of such an effort depends upon the agricultural characteristics of the region, the use of current energy products, alternate conversion technologies, and the operation of the supporting activities which collect, compact, and ship the residue on its journey from the field to final disposition. This paper delineates the various issues and shows a method of feasibility analysis which provides a uniform means of assessment of costs and energy use of alternate systems. The method is applied to examine the feasibility of direct firing residue in selected coal-fired utility boilers in Minnesota. It is found that many county-plant-operation combinations exist where the current coal cost exceeds the as-delivered cost of an energy equivalent amount of residue, suggesting that residue is a potential alternative fuel for power generation.

GASEOUS WASTE FUELS

REFER ALSO TO CITATION(S) 54618, 54619

HYDRO ENERGY

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 54839, 55315

54816 **Hydro and irrigation prospects for Iran.** *Int. Water Power Dam Constr.;* **30**: No. 7, 25-28(Jul 1978).

The vastly-increased revenues from oil which Iran gained following world-wide price rises, has led to a strong imbalance in the economy. The development of irrigation systems, and hydropower schemes will be major factors in restoring the country's equilibrium, and both these aspects of water control are being pursued with vigor.

54817 **Cerron Grande: El Salvador's largest hydro project.** Valiente, B.S. (Comision Ejecutiva Hidroelectrica del Rio Lempa, San Salvador); Roddy, R. Jr. *Int. Water Power Dam Constr.;* **30**: No. 7, 42-46(Jul 1978).

El Salvador, the smallest of the Central American countries yet the most densely populated, is continuing its program to exploit water power, in a race to reduce costly dependence on imported oil. Its latest achievement, the 270 MW Cerron Grande scheme on the country's major river, Rio Lempa, is described.

PLANT DESIGN AND OPERATION

54818 Tarbela: plans, problems and success. Binger, W.V. (Tippetts-Abbett-McCarthy-Stratton, New York). *Int. Water Power Dam Constr.;* **30**: No. 7, 29-34(Jul 1978).

The paperwork associated with a large multi-national project such as the Tarbela dam in Pakistan can present problems almost as severe as those encountered on the engineering side. The complexities involved in the administration of the scheme, as well as constructional problems resulting from the size of Tarbela, are discussed.

54819 Rolled dry lean concrete gravity dam. Moffat, A.I.B.; Price, A.C. (Newcastle-upon-Tyne Univ,. Eng.). *Int. Water Power Dam Constr.;* **30**: No. 7, 35-42(Jul 1978).

Concrete gravity dam construction is at best a semi-continuous operation, the essential principles of which have advanced little from those established in the 1930s. Construction in rolled Dry Lean Concrete (DLC), a variant of concrete peculiarly suited to mechanized handling, placing and compacting techniques adapted from embankment dam practice, offers the advantage of continuous and economic construction. The concept of the rolled DLC gravity dam is discussed, and recent research into the engineering characteristics of DLC and DLC dam profiles are described. Comparative cost studies for rolled DLC construction are summarized.

SOLAR ENERGY

54820 (AD-A—050026) **Solar energy for the naval shore establishment.** Geibel, B.B. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1977. 246p. NTIS PC A11/MF A01.

Thesis.

This thesis discusses the background and extent of the current national energy crisis, and reviews the alternative energy sources available to the United States Navy other than conventional fossil fuels. An in-depth analysis is made of the advantages, disadvantages and techniques of one of these alternatives, solar energy conversion. The National Solar Energy Program is reviewed, as is the role of the Department of Defense and the United States Navy in this program. Methods of 'retrofitting' existing Navy facilities with solar energy systems are discussed, as are new construction techniques. The thesis further contains techniques for life-cycle costing of alternative solar energy systems, which includes computer model programs such as BASIC Language, F-Chart calculations, and SOLCOST calculations. The thesis concludes with suggestions for establishing a viable solar energy program on an activity or individual basis. A comprehensive reference list and bibliography is provided to identify where technical and engineering details can be found.

54821 (DOE/CS—0027/1) **Solar Technology Transfer Program. FY 1977 program summary.** (Department of Energy, Washington, DC (USA). Div. of Solar Applications Developments). Apr 1978. 53p. Dep. NTIS, PC A04/MF A01.

Solar Technology Transfer is the critical link between the Federal Solar Energy Research, Development, and Demonstration program and the solar industry. The objective of the STTP is to provide the Department of Energy/Office of the Assistant Secretary for Conservation and Solar Applications with a major assist in transferring to industry those solar technologies with a potential for early impact application. The STTP functions to accelerate widespread commercialization of solar energy. The project summaries presented are divided into six main program elements: (1) national laboratories regional outreach, (2) installer training and education, (3) information dissemination, (4) workshops, conferences, and exhibits, (5) program support, and (6) consumer representation. An index of contractors is included. (WHK)

54822 (ORO—5278-1) **Executive summary of the National Solar Energy Workshop of the ERDA Division of Solar Energy and the state energy offices.** Christensen, D.L.; Stuhlinger, E. (Alabama Univ., Huntsville (USA). Center for Environmental and Energy Studies). Jul 1976. Contract EY-76-S-05-5278. 25p. Dep. NTIS, PC A02/MF A01.

The activities and results of the National Solar Energy Workshop held in Huntsville, Alabama, on May 19 through 21, 1976, are summarized. It was held for the express purpose of providing a forum for state participatory planning in solar-energy programs having national implications. Each of the states was invited to attend and 30 states, Puerto Rico and Canada were represented at the workshop by key members from the state energy offices and their technical assistants. Members from key Federal Agencies involved in solar-energy research, development and demonstration also participated in the workshop. The workshop was organized and structured to place emphasis on solar-radiation collection and solar-heating and cooling programs. It also formulated the Federal and State governmental interactions deemed necessary to meet National goals. The major recommendations and actions resulting from the workshop are listed.

54823 (TID—28533/1) **Comparative evaluation of solar alternatives: implications for Federal RD and D.** Witwer, J.G.; Alich, J.A.; Kohan, S.M.; Levine, M.D.; Meagher, P.C.; Pickering, E.E.; Schooley, F.A.; Slemmons, A.J.; Thompson, T.E. (SRI International, Menlo Park, CA (USA)). Jan 1978. Contract EA-77-C-01-2693. 158p. Dep. NTIS, PC A08/MF A01.

The objective of this study was to provide support to the Solar Working Group of the Department of Energy in its assessment of the balance within the federal solar energy research, development, and demonstration (RD and D) program. This study developed and applied a methodology that provided guidance to the deliberations and analyzed technical aspects of solar energy technologies. Seven groups of solar technologies were treated: solar heating and cooling of buildings, agricultural and industrial process heat, biomass, photovoltaics, thermal power, wind, and ocean thermal energy conversion. Results showed that in the near term the following are the most promising: solar heating of buildings, biomass, and wind. In the long term, the solar technology with the greatest potential of producing increased benefits under higher degrees of RD and D emphasis is photovoltaics. (MHR)

54824 (TID—28533/2) **Comparative evaluation of solar alternatives: implications for Federal RD and D.** Witwer, J.G.; Alich, J.A.; Kohan, S.M.; Levine, M.D.; Meagher, P.C.; Pickering, E.E.; Schooley, F.A.; Slemmons, A.J.; Thompson, T.E. (SRI International, Menlo Park, CA (USA)). Jan 1978. Contract EA-77-C-01-2693. 295p. Dep. NTIS, PC A13/MF A01.

Each of the seven solar energy technologies is assessed: photovoltaic devices, solar thermal power systems, wind energy systems, solar heating and cooling systems, agricultural and industrial heat processes, biomass conversion technologies, and ocean thermal energy conversion systems. A brief technical overview of storage for solar electric technologies is presented and some principles are discussed concerning how different levels of success on electrical storage can affect the commercial viability of solar electric options. The solar market penetration model that was developed and applied as an analytical tool in the study is described. The seven sections treating the solar energy technologies contain discussions in each of six subject areas: description of the technology; economic projections; the potential contribution of the technology in different marketplaces;environmental considerations;international potential; and the present and possible future emphasis within the RD and D program. (MHR)

RESOURCES AND AVAILABILITY

54825 (HCP/T5362—1) **Solar radiation data sources, applications, and network design.** (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). Apr 1978. Contract EG-77-S-05-5362. 192p. Dep. NTIS, PC A09/MF A01.

A prerequisite to considering solar energy projects is to determine the requirements for information about solar radiation to apply to possible projects. This report offers techniques to help the reader specify requirements in terms of solar radiation data and information currently available, describes the past and present programs to record and present information to be used for most requirements, presents courses of action to help the user meet his needs for information, lists sources of solar radiation data and presents the problems, costs, benefits and responsibilities of programs to acquire additional solar radiation data. Extensive background information is provided about solar radiation data and its use. Specialized information about recording, collecting, processing, storing and disseminating solar radiation data is given. Several Appendices are included which provide reference material for special situations.

54826 (SOLAR/0003—77/17) **National Solar Data Network.** (International Business Machines Corp., Huntsville, AL (USA)). Dec 1977. Contract EG-77-C-01-4049. 20p. Dep. NTIS, PC A02/MF A01.

In the National Solar Data Network, a systematic approach has been taken for the development of data requirements, instrumentation techniques, collection procedures, and analysis methods. The program to establish a large body of data on the performance of diverse solar energy systems has been implemented using a systems approach in which all steps from site study to report generation have been carefully planned. As installations are completed and an ever-expanding accumulation of data becomes available, the National Solar Data Network will be invaluable for establishing the direction to be taken by the nation in the energy field.

54827 (TID—28412) **Executive summary of the Second National Solar Radiation Data Workshop, the ERDA Division of Solar Energy and the state energy offices, Skyland, Virginia, September 26—28, 1977.** (Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center). Nov 1977. Contract EY-76-S-05-5278. 36p. Dep. NTIS, PC A03/MF A01.

This summary contains the opening remarks; the highlights of the three workshops: networks, quality control, and archive and dissemination policies for solar radiation data; and the concluding remarks. Included in appendices are: a list of papers presented, a listing of reports referenced by the speakers, and the names and addresses of workshop attendees. (MHR)

54828 (UCRL—80569) **Solar radiation reaching the ground determined from meteorological satellite data.** Ellis, J.S.; Vonder Haar, T.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1978. Contract W-7405-ENG-48. 4p. (CONF-780630—1). Dep. NTIS, PC A02/MF A01.

From 3. conference on atmospheric radiation; Davis, CA, USA (28 Jun 1978).

The results of the application of meteorological satellite measurements of solar irradiance reflected and scattered to space to the problem of determining the total solar flux received at the ground are emphasized. The method is outlined. Results of the parameterization of atmospheric absorption, intermediate to obtaining satellite derived insolation received at the ground, are discussed. A map of the mean daily insolation received at the ground for June 1975, derived from the application of the method to the NOAA-4 satellite scanning radiometer normalized brightness measurements, is presented for the contiguous United States.

54829 (UCRL-Trans—1545) **Photometric observations at Pavlovsk and the relation between light and radiation.** Yanishevskii, Yu.D. Translated from *Tr. Gl. Geofiz. Obs.;* No. 68, 102-119(1957). 38p. Dep. NTIS, PC A03/MF A01.

Portions of document are illegible.

A large part of the data on natural illumination found in monographs, textbooks, and manuals is based on the results of observations and recordings at Pavlovsk. A series of observations (1923 to 1941) and recordings (1925 to 1941) was processed without incorporating corrections, some of which had long been known. Only a small part of the observations of the early period when the methods were less advanced was published. Illumination totals in lux-hours for 1936 obtained from recordings were published in the Bulletin of the Permanent Actinometry Commission. Some of the recordings have been lost. The author took part in the observations at various stages of their development and presents here those details of the photometric methods on whose basis it will be possible to extend some corrections to similar sections of the series of observations and recordings. Some problems of geophysics and lighting engineering, and also of other branches of technology, are associated with the refinement of illumination data. This refinement owes to the solution of three problems: (1) the determination and correction of errors in previous observations; (2) the determination of illumination from data on the total and diffuse radiation, collected from a denser network of actinometric stations for which the photometric radiation equivalent must be determined; (3) the design of new photometers specially designated for stationary observations at actinometric stations, based on the data of errors in previous photometric observations. 39 references.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 55322, 55323

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 55716

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 55997

54830 (COO—4726-3) **Cuprous oxide photovoltaic cells. Progress report, January 1, 1978—March 31, 1978.** Trivich, D. (Wayne State Univ., Detroit, MI (USA)). Apr 1978. Contract ET-78-S-02-4726. 12p. Dep. NTIS, PC A02/MF A01.

The emphasis of this project is on Metal-Cuprous Oxide photovoltaic cells with oxide interlayers e.g., Al/Al_2O_3/Cu_2O structures which are referred to as MIS structures. Several Al/Al_2O_3/Cu_2O cells were prepared with V/sub oc/ approximately 0.6 to 0.7 V which is distinctly higher than the 0.35 V usually obtained with normal good cells of Cu/Cu_2O or Al/Cu_2O. The I-V characteristics of these cells are shown. Topics discussed include aluminium oxide interlayers, antimony oxide interlayers, improvements in conductivity of Cu_2O, and Auger and ESCA studies. (WHK)

54831 (DOE/JPL/1012—3) **LSSA Project. Project quarterly report No. 4, January—March 1977.** (Jet Propulsion Lab., Pasadena, CA (USA)). 1977. Contract EX-76-A-29-1012. 89p. Dep. NTIS, PC A05/MF A01.

A preliminary version of a workbook for SAMICS, a uniform costing methodology for manufacturing processes, was published. Continued experimentation with the fluidized bed reactor for production of Si by Zn reduction of $SiCl_4$ showed that 78 percent of theoretical conversion efficiency from $SiCl_4$ to Si was attainable using a hemispherical bed support, versus 68 percent when using the concise bed support. The EFG process is now producing 2-inch wide ribbon at 2 to 3 inches per minute; however, conversion efficiencies remain low at 2 percent to 3 percent. Work on the CAST process has stopped pending contract negotiation. Materials other than SiO_2 are being evaluated for the die used in the inverted Stepanov process. Development of low-cost encapsulation materials and systems is continuing. Production process emphasis was shifted to the cost-effectiveness of processes still being considered, and to the sensitivity of these processes to commercially realistic tolerances. Engineering work centered in two primary areas: the finalizing of a substantially updated module design specification, and expanded activity in the development of environmental design requirements. (MHR)

54832 (DOE/JPL/954376—5) **Laser-zone growth in a Ribbon-to-Ribbon (RTR) process. Silicon sheet growth development for the Large Area Silicon Sheet Task of the Low-Cost Silicon Solar Array Project. Technical quarterly report No. 7, January 1—March 31, 1978. Motorola report No. 2256/9.** Gurtler, R.W.; Baghdadi, A.; Legge, R.; Sopori, B.; Ellis, R.J. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1978. Contract NAS-7-100-954376. 103p. Dep. NTIS, PC A06/MF A01.

Substantial progress has been made both in crystal growth and in processing. A growth rate of 12.5 cm/min with 2 cm wide ribbon was achieved. This high growth-rate ribbon has a dendritic structure. The maximum non-dentritic growth rate was increased to 8 to 9 cm/min by using active cooling (inert gas jets) to steepen the postheater temperature gradient. Also, RTR ribbon was grown from 2.5 cm wide CVD polycrystalline feedstock. Doped CVD feedstock can now be grown in widths from 1 in. to 3 in., and thicknesses from 125 μm to 250 μm. The poly ribbon thickness is uniform within +-5 percent along the length of the ribbon. First attempts to grow 5 cm wide ribbon from CVD feedstock were only partially successful, due to buckling in the ribbon prior to crystallization. This buckling creates both longitudinal and lateral curvatures in the ribbon. The curvature is often so great that the sample cannot pass through the 0.1 in. wide slot of the postheater. The probable cause for this buckling is the non-ideal longitudinal temperature distribution. The temperature profile must be controlled in the feedstock ribbon (as well as in the growing ribbon) in order to overcome this problem. Solar cells were fabricated on dendritic ribbon. Preliminary measurements indicate that their performance is at least as high as cells fabricated on non-dendritic substrates.

54833 (DOE/NASA/1022—78/33) **Endurance testing of first generation (Block I) commercial solar cell modules.** Anagnostou, E.; Forestieri, A.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1978. Contract EX-76-A-29-1022. 9p. (CONF-780619—13; NASA-TM—78922). Dep. NTIS, PC A02/MF A01.

From IEEE photovoltaic specialists conference; Washington, DC, USA (5 Jun 1978).

One phase of the Department of Energy (DOE) Solar Cell Photovoltaic Program is to develop low-cost solar cell arrays with a 20-year lifetime. In order to help determine lifetimes of the first generation (Block I) commercial solar cell modules used in these arrays, a program was initiated by DOE/NASA-Lewis Research Center to expose these modules to a range of environments. Accordingly, Block I modules from four manufacturers were installed at commercial testing sites in Florida, Puerto Rico, and Arizona and at noncommercial sites in Cleveland, Ohio. The effect of outdoor exposure on the performance of the modules was determined using current-voltage curves. Short-circuit current (I/sub sc/) and maximum power (P/sub max/) were the parameters monitored. In order to determine the effect of dirt on performance, some modules were washed periodically and their parameters were recorded both before and after washing. In all cases, there was a loss of performance of the modules with outdoor exposure. The loss was dependent not only on the exposure site but also on the module construction. Three types of modules are covered with silicone pottants and one type has, in addition, a glass cover. This latter type of module had a loss in P/sub max/ only one-quarter to one-sixth that of the other modules in a comparable period of time. For all modules, some of

the performance loss could be recovered by washing. Except for glass-covered modules, where the loss in P/sub max/ could be completely recovered each time, each succeeding washing recovered less. Thus, the silicone-covered modules showed a permanent loss in performance. Many modules showed edge delaminations and/or delaminations under cells and interconnects. These did not seem to seriously affect power output. Results from these exposure tests indicate that delamination and dirt retention are likely trouble spots in solar cell modules.

54834 (SAND—78-0945) **Photovoltaic concentrator test and evaluation plan. Concentrator Technology Development Project of the DOE National Photovoltaic Conversion Program.** Jones, G.J. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Jun 1978. Contract EY-76-C-04-0789. 45p. Dep. NTIS, PC A03/MF A01.

The DOE National Solar Photovoltaic Conversion Program is structured into several interrelated projects which address the major segments of the overall effort. Of these segments the responsibility for conducting the Systems Definition and Concentrator Technology Development Projects is assigned to Sandia Laboratories. The Concentrator Technology Development Project has as its overall goal to develop low-cost reliable photovoltaic concentrator subsystems. The evolution of these collectors demands on determining the positive and negative aspects of developmental collector materials and configurations and feeding this information back into the design process. Therefore, the effectiveness of each collector needs to be evaluated in detail from the viewpoint of efficiency and lifecycle costs. A brief description of Sandia's capabilities and plans for carrying out this testing is presented.

54835 Studies on the performance of a small sealed Ni—Cd button cell as a power source for an electronic watch. Masago, H.; Kitagawa, T.; Kohno, K. *Yuasa Jiho;* No. 44, 41-47(Apr 1977). (In Japanese).

Among possible candidates in small secondary cells as a power source for an electronic watch which would be used in combination with solar cells or other alternative means to charge the secondary cells, a sealed Ni—Cd button cell, model 20F, was chosen and its electrical and other performances were examined. As a conclusion it was found that the small, sealed Ni—Cd button cell could be used for this application provided that leakage control is improved and the capacity in the same volume is increased. 18 figures, 4 tables.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 54797, 54799, 54807, 54808, 54815

PHOTOVOLTAIC POWER PLANTS

54836 (AD-A—048908) **Solar electric generating system resource requirements and the feasibility of orbiting solar reflectors. Master's thesis.** Enger, R.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1977. 187p. (AFIT/GEP/PH—77D-3). NTIS PC A09/MF A01.

The potential consumption of natural resources by four solar electric generating systems was evaluated. They included a terrestrial solar thermal, a terrestrial photovoltaic, an orbiting solar reflector, and a satellite solar power system. Each was evaluated on its projected consumption of materials, land, water, manpower, energy, and money. The evaluation demonstrated that, per megawatt of electrical generating capacity, the terrestrial systems would consume less resources mainly because they would not require massive space transportation and construction systems and expensive developmental programs. It was also shown that construction of terrestrial systems would require fewer technological advancements and would pose less of a threat to the environment. A feasibility study of orbiting solar reflectors demonstrated that single-mirror systems may be useful for intra-space power generation. The report contains a 47-item bibliography.

54837 (COO—4094-7) **Safety procedures for the 25-kW solar photovoltaic array at Mead, Nebraska.** Forman, S.E.; Landsman, E.E. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 7 Apr 1978. Contract EY-76-C-02-4094. 25p. Dep. NTIS, PC A02/MF A01.

Since the 25-kW solar photovoltaic agricultural field test system at the University of Nebraska is a unique electrical power system, special safety rules and regulations are needed to govern its operation. Field inspection and maintenance operations require the handling of electrically active elements during daylight hours. The methods and techniques necessary to perform these operations in a safe manner and to make field personnel more safety conscious as well are enumerated.

54838 (N—78-13102) **Solar power satellite. System definition study. Part 1, Volume 4: SPS transportation system requirements.** (Boeing Aerospace Co., Seattle, WA (USA). Space Div.). 1 Aug 1977. Contract NAS9-15196. 48p. (NASA-CR—151557; D—180-20689-(Pt.1)(Vol.4)). NTIS PC A03/MF A01.

The best estimates of space transportation requirements for cargo launch vehicles, personnel launch carriers, high thrust orbit transfer, and electric orbit transfer systems are discussed, along with the rationale for each.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 55833

54839 Hydroelectric solar energy conversion. Liboff, R.L. (Cornell Univ., Ithaca, NY). *Energy Sources;* **3**: No. 3/4, 255-261(1978).

A means of direct conversion of solar energy to hydroelectric energy is discussed. The mechanism is appropriate to low-lying coastal desert regions with high potential evaporation rates. Formulas for output power are obtained. Climate and related data appropriate to suitable locations are included. Consider an arid domain with large annual potential evaporation and vanishingly small precipitation. Let the domain be approximately at sea level (or a natural depression) and close to a great body of water. A large deep basin is excavated in the domain and a canal is constructed from the sea to the depression. Hydroelectric energy is obtained from the fall of the sea water into the depression. The water so fed into the basin evaporates during the sunlight hours. The generators run over the maximally efficient portion of the 24-h day. The cycle of fall, together with evaporation and lift, effects a Carnot cycle.

CENTRAL RECEIVER

54840 (SAN—1108-8) **Central Receiver Solar Thermal Power System, Phase 1: CDRL Item 2, Pilot plant preliminary design report. Volume 1. Executive overview.** Hallet, R.W. Jr.; Gervais, R.L. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Oct 1977. Contract EY-76-C-03-1108. 88p. (MDC-G—6776(Vol.1)). Dep. NTIS, PC A05/MF A01.

This summary introduces the McDonnell Douglas Astronautics Company (MDAC) Central Receiver System Preliminary Design and reports the results of the Subsystem Research Experiments (SRE) recently completed. The baseline central receiver concept defined by the MDAC team consists of the following features: (A) An external receiver mounted on a tower, and located in a 360-deg array of sun-tracking heliostats which comprise the collector subsystem. (B) Feedwater from the electrical power generation subsystem is pumped through a riser to the receiver, where the feedwater is converted to superheated steam in a single pass through the tubes of the receiver panels. (C) The steam from the receiver is routed through a downcomer to the ground and introduced to a turbine directly for expansion and generation of electricity, and/or to a thermal storage subsystem, where the steam is condensed in charging heat exchangers to heat a dual-medium oil and rock thermal storage unit (TSU). (D) Extended operation after daylight hours is facilitated by discharging the TSU to generate steam for feeding the admission port of the turbine. (E) Overall control of the system is provided by a master control unit, which handles the interactions between subsystems that take place during startup, shutdown, and transitions between operating modes.

54841 (SAN—1108-8/6) **Central receiver solar thermal power system, Phase 1. CDRL item 2. Pilot plant preliminary design report. Volume VI. Electrical power generation and master control subsystems and balance of plant.** Hallet, R.W. Jr.; Gervais, R.L. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Oct 1977. Contract EY-76-C-03-1108. 410p. (MDC-G—6776(Vol.6)). Dep. NTIS, PC A18/MF A01.

The requirements, performance, and subsystem configuration for both the Commercial and Pilot Plant electrical power generation subsystems (EPGS) and balance of plants are presented. The EPGS for both the Commercial Plant and Pilot Plant make use of conventional, proven equipment consistent with good power plant design practices in order to minimize risk and maximize reliability. The basic EPGS cycle selected is a regenerative cycle that uses a single automatic admission, condensing, tandem-compound double-flow turbine. Specifications, performance data, drawings, and schematics are included. (WHK)

54842 (SAN—1108-76-7) **Central Receiver Solar Thermal Power System, Phase 1. CDRL Item 10. Final technical progress report.** Hallet, R.W. Jr.; Gervais, R.L. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). May 1978. Contract EY-76-C-03-1108. 133p. (MDC-G—6955). Dep. NTIS, PC A07/MF A01.

Results of analysis and design efforts by McDonnell Douglas Astronautics Company (MDAC), Rocketdyne, Stearns-Roger, Inc., Sheldahl, Inc., and the University of Houston between 1 July 1975 and 30 June 1977 are summarized. This is the Final Technical Progress Report published on the Phase 1 Central Receiver Solar Thermal Power System contract. Historical summaries and final selection of 10-MWe pilot plant and 100-MWe commercial systems are presented, with emphasis on the collector field characteristics, overall system performance, selection of steam/feedwater operating conditions, and rationale for system and subsystem selection. The commercial and pilot plant designs, as well as the subsystem research experiment activities for the collector, receiver, and thermal storage subsystems are presented, including a historical summary, design summary, and a description of the overall SRE test program and major test results for each of the subsystems.

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 55997

SOLAR RADIATION UTILIZATION

SPACE HEATING AND COOLING

54843 (COO—2939-5) **Solar space heating systems using annual heat storage. Progress report, July 1—December 30, 1977.** Hooper, F.C.; Attwater, C.R.; Brunger, A.P.; Cook, R.J.D.; McClenahan, J.D. (Toronto Univ., Ontario (Canada). Dept. of Mechanical Engineering). Feb 1978. Contract EY-76-C-02-2939. 135p. Dep. NTIS, PC A07/MF A01.

The development of practical design methods and the evaluation of observed performance data from instrumented annual storage systems is reported. The application of new analysis and survey work to engineering design is presented. The previously developed computed simulation is extended to derive new methods of determining cost optimal annual storage systems operating under specified conditions. The development of new methods of analysis of the behaviour of soil heat flow and solar collector models is reported. The preparation of reports and scientific papers on the task, and work on related academic projects is outlined.

54844 (COO—4495-3) **Solar-MEC development program. Project 9103 quarterly progress report, September 1—November 30, 1977.** Staats, W.R.; Wurm, J. (Institute of Gas Technology, Chicago, IL (USA)). Dec 1977. Contract EG-77-C-01-4495. 16p. Dep. NTIS, PC A02/MF A01.

Arrangements for desiccant wheel performance tests, initial work on the computer model of dynamic behavior of the desiccant wheel, and the laboratory program are discussed. Formal arrangements are underway for a subcontract to Cargocaire Engineering Corp. to measure the drying performance of the Solar-MEC molecular sieve desiccant wheel. After negotiations for more detailed testing, it was decided that tests of the type originally proposed to the Solar Heating and Cooling Research Branch of DOE would be most suitable. Evaluation of an earlier computer model of the desiccant wheel, developed by AB Carl Munters, Sweden, indicated that it will be most effective to modify that program for use in this project, rather than use one that had been developed earlier at IGT. Both programs are based on essentially the same physical model of the drying and regeneration processes. The equipment needed for characterizing air-leak rates and identifying leakage paths has been designed and assembled. Tests will start soon.

54845 (EPRI-ER—771) **EPRI Methodology for Preferred Solar Systems (EMPSS) computer program documentation. User's guide.** Nathanson, D.; Merriam, R.L. (Little (Arthur D.), Inc., Cambridge, MA (USA)). May 1978. 275p. Dep. NTIS, PC A12/MF A01.

A computer program was developed by which the behavior of residential solar heating and cooling systems could be analyzed. Unlike several other programs by which buildings and the performance of solar heating and cooling equipment can be analyzed, this program is capable of estimating the cost of backup electrical energy from a utility's actual cost of supply, in addition to its rate structures. In its present form the program permits the specification of a wide variety of solar or conventional heating and cooling devices which use electrical energy. Both the thermal loads of the residence and the utility's system-wide load are dependent upon a weather tape which is used in hourly computations extending over one year. Monthly costs of electrical energy are based upon the hourly electrical demand of the residence and the utility's cost-of-supply model. When combined with equipment costs and specified economic parameters, these monthly energy costs are used to predict total life-cycle costs for each system considered, and to show payback periods when compared with conventional equipment. Detailed descriptions of the program elements and of its input and output data streams are provided.

54846 (HCP/M70066—01/1) **Solar Heating and Cooling of Buildings (SHACOB) Commercialization Report. Part B. Analysis of market development. Volume I. Executive summary, September 1977.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). May 1978. 25p. Dep. NTIS, PC A02/MF A01.

A quantitative model is described which is capable of generating market penetration figures for the solar heating and cooling of buildings under a wide range of assumptions. The results of the model are analyzed and compared with various solar incentive scenarios and data base assumptions. (MHR)

54847 (HCP/M70066—01/3) **Solar Heating and Cooling of Buildings (SHACOB) Commercialization Report. Part B. Analysis of market development. Volume III. Appendices, September 1977.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). May 1978. 58p. Dep. NTIS, MF A01.

Portions of document are illegible.

Appendices are presented which support the technical discussions in Volume II. These are model documentation, major model assumptions, and incentives. (MHR)

54848 **Sun house with multipurpose collectors.** Loebbecke, W. *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **3**: No. 2, 21(1978). (In German).

A report is given on the application of solar energy to building heating and warm water heating. The erected house is designed so as to greatly reduce the energy consumption, so that the solar system and heat pump are a sufficient supply. The investment costs were 4,000 DM more than that of a common oil-firing system.

54849 **Designing and building a solar house. Your place in the Sun.** Watson, D. Charlotte, VT; Garden Way Publishing (1977). 288p. $12.95.

The way solar heating works and how you can use it are explained. The historical and "passive" uses of solar energy, the "active" systems of solar collection that have been developed, and how to choose a combination of solar heating methods that are best for your site are described in detail. The need for climate design, site planning, the importance of "ecodesign" in solar house construction, and outstanding solar house designs are covered thoroughly. Photos show the step-by-step construction of self-help solar homes. Detailed forms are included for calculating size and payback period for a system. (MHR)

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

54850 **Europe's largest solar plant dries fodder.** Urbanek, A. *Mitteilungsbl. Dtsch. Ges. Sonnenenergie;* **3**: No. 1, 21-22(1978). (In German).

A report is given on a solar dryer. A thermal power of maximum 1 MW is obtained with a collector surface of 1,500 m^2 and a reflector surface of about 2,100 m^2. The collector efficiency is about 64 to 84%. Air is used as heat transport medium. About 180,000 l heating oil is to be saved per year by this plant.

WATER HEATING

REFER ALSO TO CITATION(S) 54848, 54858

54851 (EPRI-ER—794) **Hot water system efficiency study at South County Hospital, Wakefield, Rhode Island.** Cummings, R.D.; Peck, D.J.; Hall, W.J. (Daystar Corp., Burlington, MA (USA)). Jun 1978. 41p. Dep. NTIS, PC A03/MF A01.

Daystar Corporation installed a solar/electric domestic water heating system in the Borda Wing of the South County Hospital, Wakefield, R.I. in 1975. Initial performance measurements showed that the overall water heating system efficiency was approximately 35 percent. To deliver one unit of hot water "at the faucet" required three units of energy input. This study was undertaken to identify the losses which caused this low efficiency and possible improvements which could be made at the South County installation and in future similar installations.

54852 (SES—9) **Performance of three Australian solar hot water systems. Final report.** Salt, H. (Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia)). Jul 1977. 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Three Australian hot water systems have been monitored for about 18 months using simple and inexpensive instruments. Tables showing average weekly and monthly performance figures for the systems over the monitoring period are presented. A monetary value is estimated for the solar energy delivered by each system, and the results are discussed.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 54834

54853 (AD-A—049982) **High-temperature linear radiation-cavity solar collector with a fresnel concentrator.** Antoniak, Z.I. (Pennsylvania State Univ., University Park (USA). Applied Research Lab.). 8 Dec 1977. Contract N00017-73-C-1418. 235p. (TM—77-326). NTIS PC A11/MF A01.

Thesis.

A model solar-thermal concentrator-collector that is 1/6th scale (in cross section) relative to a system considered to be of practical dimensions for power generation has been constructed and tested. It consists of an Archimedes (i.e., Fresnel) mirror-concentrator, 5 cm ID x 1.5 m long glass receiver pipe, 0.3 cm thick graphite absorber, and gaseous (Ar) heat transfer medium. On clear days (direct solar flux ca. 800 W/sq.m.), stagnation (i.e., no-flow condition) temperatures of ca. 370 C have been reached at the center of the experimental device, where end effects are minimal. Experiments have been performed with gas flow rates up to ca. 100 liters/min (200 RE 2000), resulting in a bulk fluid temperature rise in the axial (flow) direction of up to 285 C. These experiments have been utilized in a study of heat transfer processes within the collector. A computer model of this system which takes into account most of the influential variables (e.g., combined forced-free convection, establishment of velocity and temperature profiles, and axial heat conduction) has been developed. Its behavior agrees well with observations. Also, after ca. 200 h of high-temperature operation, materials degradation was measured and found to be very low.

54854 (PRRL—78-CR-18) **Materials for solar thermal conversion. Quarterly report No. 2, 1 January 1978—31 March 1978.** Gittleman, J.I. (RCA Labs., Princeton, NJ (USA)). Apr 1978. Contract EG-77-C-02-4557. 15p. Dep. NTIS, PC A02/MF A01.

The research program is designed to evaluate composite semiconductors as selective absorbers for photothermal converters of solar energy. Films (0.5 μm thick) of Ge—CaF_2 containing approximately 40 vol percent Ge were sputtered onto anodized, polished Al substrates. Reflectance measurements indicated that these specimens have high absorptance and low infrared emittance. These specimens exhibited the highest selectivity of any specimens thus far produced. The calculated solar thermal conversion efficiency for a device operating at 500°C (airmass = 1) was 22 percent at a concentration ratio of 2, 54 percent at a ratio of 6, and 61 percent at a ratio of 10. Auger/ESCA studies show the composite films to be composed largely of semiconductor grains in a matrix of CaF_2 which is consistent with optical studies. In addition it has revealed an oxidized surface layer approximately 50 A deep, due probably, to atmospheric oxygen, and whose chemistry is uncertain. Characterization studies have not revealed: (a) the size of the semiconductor grains, or (b) the presence of any evidence of chemical reaction between the semiconductor and the CaF_2.

54855 (SAND—78-0624) **Performance testing of the General Atomic Fixed Mirror Solar Concentrator.** Dudley, V.E.; Workhoven, R.M. (EG and G, Inc., Albuquerque, NM (USA); Sandia Labs., Albuquerque, NM (USA)). May 1978. Contract EY-76-C-04-0789. 35p. Dep. NTIS, PC A03/MF A01.

The testing which was performed on the General Atomic Fixed Mirror Solar Concentrator at the Midtemperature Solar Systems Test Facility is summarized. Test objectives are defined, test procedures are described, and results and conclusions are given.

54856 (SAND—78-0881C) **Concentrating solar collector test results from DOE/Sandia Collector Module Test Facility.** Dudley, V.E.; Workhoven, R.M. (EG and G, Inc., Albuquerque, NM (USA); Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 7p. (CONF-780550—6). Dep. NTIS, PC A02/MF A01.

From Seminar on testing solar energy materials and systems; Washington, DC, USA (22 May 1978).

A series of concentrating solar collectors are being tested in the Collector Module Test Facility (CMTF). The objective of the test series is to characterize the performance of concentrating solar collectors. Of primary concern is the peak thermal efficiency at solar noon and receiver thermal losses of these collectors over the temperature range from about 100 to 300°C. Five collectors were tested from August 1977 to January 1978, and results of these tests are reported. Others are now being tested, with more scheduled for test at about 2 month intervals.

54857 **Air-heating solar collector.** Lyon, F.A.; Harrison, H. (to Halm Instrument Co., Inc.). US Patent 4,086,909. 2 May 1978. Filed date 15 Jul 1976. 4p.

An air-heating solar collector is described having a plurality of parallel, spaced-apart, substantially coextensive translucent sheets and a convoluted air passage passing in succession between successive pairs of said sheets, the air finally passing over a blackened absorber plate. Heat escaping from the absorber to the sheets is picked up by air flowing in the convoluted air passage.

54858 **Solar heating device.** Futch, W.O. US Patent 4,086,911. 2 May 1978. Filed date 28 Apr 1976. 2p.

A solar heating system is disclosed of the type used to heat hot water or like fluid for domestic or industrial use comprising a collector assembly including fluid storage facilities formed on the interior thereof and exterior portion surrounding the fluid storage facilities. A collector unit including a coil element wound continuously about the exterior portion and disposed to define part or all of the exposed surface of the exterior portion wherein this exterior portion further is arranged at an angular orientation between a base and head segment of the collector assembly. A transparent or light permeable casing surrounds the entire collector assembly wherein the entire collector assembly is connected in fluid communicating relation with a preheater assembly which includes a fan and is preferably mounted in an attic or other environment wherein the surrounding temperature is greater than ambient temperature.

54859 **Solar collector panel.** Freeman, J.M. US Patent 4,086,912. 2 May 1978. Filed date 4 Nov 1976. 4p.

A solar collector panel is disclosed characterized by an integral base having a heat transfer liquid channel and weir at each end of a corrugated heat transfer surface. The channel and weir define a self-contained heat transfer liquid system which provides for the even distribution and collection of such liquid over and from the heat transfer surface.

54860 **Solar heat collector construction.** Gavin, J.G. (to Grumman Aerospace Corp.). US Patent 4,086,913. 2 May 1978. Filed date 15 Dec 1976. 4p.

A solar heat collector is described having an array of liquid transporting tubes and a plurality of heat absorber panels joined by a tube gripping accommodation on each panel providing structural integrity and good thermal conductivity.

54861 **Solar air heater.** Severson, A.M.; Sampson, R.L. (to Honeywell Inc.). US Patent 4,085,730. 25 Apr 1978. Filed date 10 Nov 1976. 6p.

A low-cost solar air heater is disclosed which utilizes an array of jets to produce impingement of the air on the lower surface of the absorber plate which enhances heat transfer efficiency.

54862 **Method to produce a selectively absorbing surface for solar collectors and equipment to carry out the method.** Scherber, W. (to to Dornier-System G.m.b.H.). German(FRG) Patent 2,551,832/B/. 21 Apr 1977. 6p. (In German).

The invention deals with a method to produce a selectively absorbing surface for solar collectors with a metallic base body. Firstly a metal layer is coated on the metallic base body by galvanic means. This metal layer has a selective absorbing surface produced by treatment with a glow discharge. According to the base material used, either selective oxides or selective nitrides, borides, or carbides are produced. The types of glow discharges required for the various coatings are discussed.

HEAT STORAGE

REFER ALSO TO CITATION(S) 54843

54863 (DOE/NASA/1034—78/1) **Storage systems for solar thermal power.** Calogeras, J.E.; Gordon, L.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1978. Contract EC-77-A-31-1034. 11p. (CONF-780801—24; NASA-TM—78952). Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

A major constraint to the evolution of solar thermal power systems is the need to provide continuous operation during periods of solar outage. A number of high temperature thermal energy storage technologies which have the potential to meet this need are currently under development. The development status is reviewed of some thermal energy storage technologies specifically oriented toward providing diurnal heat storage for solar central power systems and solar total energy systems. These technologies include sensible heat storage in caverns and latent heat storage using both active and passive heat exchange processes. In addition, selected thermal storage concepts which appear promising to a variety of advanced solar thermal system applications are discussed.

54864 **Storage of solar energy.** Wettermark, G.; Kowalewska, J. Stockholm; Tekniska Hoegskolan (1976). 14p.

Heating of buildings with solar energy is discussed. The storage of heat will constitute the most operable possibilities in the near future. The storage of solar energy through conversion into

electrical or chemical energy can, however, provide more appealing solutions in the more distant future. An overview is given of possible solar energy storage methods, conversion to electricity, storage with the help of chemical reactions and heat storage.

GEOTHERMAL ENERGY

RESOURCE STATUS AND ASSESSMENT

USA

54865 California's geothermal resource potential. Liebowitz, L.P. (Jet Propulsion Lab., Pasadena, CA). *Energy Sources;* **3**: No. 3/4, 293-311(1978).

Currently the largest geothermal electric generation facility is located in California. The dry-steam resource type being used at the Geysers is economically attractive, but its occurrence is quite rare. However, there are indications that large quantities of untrapped hydrothermal resources may make the state one of the richest geothermal regions in the world. Geothermal resources in California have the potential for providing a significant amount of the state's future energy needs. From what is now known, California contains 72 percent of the currently usable geothermal resources in the United States. By comparison, California's neighboring states have one-tenth of this state's estimated resources. An overview of California's geothermal resource areas, estimates of their potential resources, and comparisons with the state's energy consumption are given. The key factors that currently impede the full-scale exploration and development of geothermal energy are summarized.

NON-USA

REFER ALSO TO CITATION(S) 54871

54866 Situation of geothermal resources in Japanese primary energy. Hirakawa, S. (Tokyo Univ.). *J. Jpn. Geotherm. Energy Assoc.;* **15**: No. 1, 7-10(Mar 1978).

From 3. annual workshop on geothermal reservoir engineering; Stanford, CA, USA (14 Dec 1977).

Factors considered in the formulation of a Japanese energy plan are discussed. Emphasis is placed on the potential contribution of geothermal energy. (JGB)

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

USA

REFER ALSO TO CITATION(S) 54892

NON-USA

REFER ALSO TO CITATION(S) 54876, 54879

54867 (CONF-7710140—2) **Geological background of geothermal belts in the central part of Kyushu.** Yamazaki, T.; Hayashi, M.; Matsumoto, Y. (Kyushu Univ., Fukuoka (Japan)). 1977. 2p. (In Japanese). TIC.

From Meeting on underground resources; Kyushu, Japan (Oct 1977).

Kyushu is located at the intersection points of the Honshu and Ryukyu arcs. Volcanic activity is controlled by the island arc structure, consequently both the Sanin and Ryukyu volcanic systems are closely topographically related to the arcs. Between the two volcanic systems lies an extensive belt of geothermal activity which arises from the post-volcanic activity of both. The area is characterized by depression structures and grabens, typical of the Circum-Pacific orogenic belt. The depressions are filled with sediments derived from post-Tertiary volcanics. These sediments form both reservoir rock and cap rock, depending on their degree of permeability. Faulting associated with calderas and siliceous rock domes serve as paths for the transport of geothermal fluids. These fault systems tend to be of very high complexity.

54868 (NP—23244) **Report on precision investigation for geothermal exploitation of Satsunan, 1975.** (Geological Survey of Japan, Kawasaki, Kanagawa). Mar 1976. 138p. (In Japanese). TIC.

Precision geothermal investigations were carried out for a 30 km^2 area near Ibusuki City in the northeastern part of Unagi-Ike. The studies included structural drilling, logging, and an electrical survey of a 15 km traverse which was performed at 250 m intervals and penetrated as deep as 2000 m. Three major boreholes were sunk: SA1, SA2, and SA3. Borehole SA1 intercepted a hydrothermal reservoir at 131.7 m. This shallow reservoir had an abnormal temperature gradient of 1.61°C/m. The thermal gradient in SA1 dropped between the shallow reservoir and 200 m, then rose again, reaching 247°C in a high-temperature reservoir at a depth of 500 m. This reservoir is at least partially fed by sea-water. An even higher-temperature reservoir is believed to lie at greater depth. No reservoirs were intercepted by borehole SA2, but a high thermal gradient shows promise of a reservoir at depths greater than 500 m. The third borehole, SA3, encountered a 170°C reservoir at the terminal depth (500 m). The existence of these reservoirs confirmed the predictions made by electrical-survey data-analysis. Approximately 54 maps, tables, and sections are provided.

54869 (NP—23249) **Precision survey of the Toyoha—Jozankei geothermal field.** (Geological Survey of Japan, Kawasaki, Kanagawa). Mar 1976. 150p. (In Japanese). TIC.

The geological and geothermal structure of the Toyoha-Jozankei geothermal field was investigated in detail. The studies included two structural boreholes of 500 m depth, which were sunk between August 7, 1975, and March 31, 1976, in the Shiraikawakita and Yunosawa areas. Examination of the cores revealed remarkable differences in the conditions of pyrophyllite layers bounding dacitic strata between 215 and 255 m depth. The upper boundary was characterized by strong hydrothermal alteration, while the lower boundary was hard, impermeable, and showed little alteration. The temperature at a depth of 500 m was 212°C, with a soil temperature gradient of 26°C/100 m and a heat flow of 19.3 HFU (846.7 mW/m^2). The results indicate the presence of extensive geothermal resources in the area. Approximately 70 maps, tables, and flow charts are provided. These include various logs, analytical results, and litho-stratigraphic columns.

54870 Measurements of the streaming potential caused by the Zenikawa geyser (Part 1). Itoh, Y.; Saitoh, T.; Nagumo, M. *J. Jpn. Geotherm. Energy Assoc.;* **15**: No. 1, 19-27(Mar 1978). (In Japanese).

There is a small geyser at Zenikawa Hot Spring in Akita Prefecture. The geyser orifice is surrounded by the hot pool, which is circular, about 2 m in diameter, about 30 cm deep and at about 75°C, aside from the geyser eruptions. The geyser plays at intervals ranging from 20 to 50 minutes with eruption duration ranging from 3 to 5 minutes and water temperature increases of more than 96°C. An attempt was made to obtain the evidence of arising the streaming potential caused by the geyser eruption on Sept. 11 and Nov. 26, 1977. The streaming potential as a function of time was measured by using the electronic recorders and several lead electrodes placed at a depth of ranging from 15 to 25 cm in soil at a distance of 1m, 2m, 4m, and 6m, respectively, from the geyser orifice. Moreover, the variation of water temperature with eruption time and activity of the geyser was measured in the hot pool, by setting a thermistor in the geyser orifice and filling with pebbles and stones. The attempt to trace the streaming potential was successful. It can be shown that the empirical equation for the maximum values of streaming potential accompanied the several eruptions of geyser is $V = -0.3 \ln x$, where V is streaming potential in milli-Volt, x is distance from geyser orifice in meter and minus is downward potential to the geyser. And the eruptions are usually followed by the abruptly initiated potential increase.

54871 Geothermal indications and hot springs of Hokkaido, Japan. A. Southwestern area. *Hokkaido Chika Shigen Chosa Shiryo;* No. 3, 1-168(1976). (In Japanese).

There are, at present, 49 hot spring areas located in the south-central portion of southwestern Hokkaido. Of these 33 are natural springs and the remainder have resulted from developmental drilling. The springs are distributed in distinct areas. One group includes Misaki, Esan, Mizunashi, Kakkuni, Ofuna-Kaminoyu, Ofuna-Shimoniyu, Isoya, Shikabe, Tomenoyu, Onuma, Nigorikawa, Rakubu-Kaminoyu, Sakurano, and Namarikawa. Another group includes Nagatomi, Gunai, Hakukaga, Hakuogon, and Chigase, extending via the Okujiri Strait to Okujiri Island. These two groups comprise springs with temperatures in the neighborhood of 40 to 50°C. Springs in other areas include Yubetsu, Nedoi, Tanegawa, Yunotai, etc. The temperature of these springs ranges from 26.5°C to 103°C (Shikabe), and the total outflow of water is about 34 kl/min. About 14.6 kl/min is natural flow and about 19 kl/min is from drilled wells. The springs having the greatest output are Todomeki, Yunokawa, Kennichi, Onuma, Tomenoyu, and Nigorikawa. Two large maps are provided as appendices, and 171 references are given.

GEOTHERMAL EXPLORATION AND

EXPLORATION TECHNOLOGY

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 54868, 54869, 55949

54872 (CONF-7710140—1) **Geothermal exploitation of the Nigorikawa area of Hokkaido.** Nakamura, H. (Corporate Unverified). 1977. 3p. (In Japanese). TIC.

From Meeting on underground resources; Kyushu, Japan (Oct 1977).

Geothermal exploration in the Nigorikawa area of Hokkaido since 1972, including the drilling of five exploratory wells. After the completion of geological, geochemical, gravity, and electrical surveys, studies were made of alteration zones and thermal discharge characteristics in cooperation with the Sunshine Project, and detailed seismic surveys were made after 1973. These studies revealed the presence of an extended geothermal resource area, covering the northeastern sector of the Nigorikawa Basin. A well-bottom temperature of 180°C was logged at a depth of 469 m, and hot water and steam were obtained. Other wells have demonstrated temperatures of 200 to 243°C, and an abrupt increase in temperature occurs below about 600 to 700 m, giving a reasonable expectation of a reservoir extending over an area of 1.5 x 2.5 km and having an average temperature exceeding 200°C. Plans call for the installation of a 50 MW power plant. Excavation of production walls began in August, 1977, and it is hoped that the facility will be completed in 1978.

54873 (LBL—7054) **Seismological investigations in geothermal regions.** Majer, E.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1978. Contract W-7405-ENG-48. 236p. Dep. NTIS, MF A01.

Portions of document are illegible. Thesis.

Seismological methods, including studies of microearthquakes, P- and S-wave velocities and P-wave attenuation were investigated as tools for the exploration and delineation of geothermal resources. Seismograms from explosions and microearthquakes were examined for changes in frequency content and relative arrival times across a known geothermal area, The Geysers, California, and a potential geothermal region, Grass Valley, Nevada. Microearthquakes within the two regions were examined for evidence of spatial variations in radiated P- and S-waves. Additional information concerning Basin and Range structure was provided by regional refraction studies. Detailed structural analysis in Grass Valley was obtained by commercial reflection and refraction work. Heat flow modeling, consistent with structure inferred by seismological techniques, was used to discriminate between conductive and convective heat flow anomalies in Grass Valley. Concentrated observations in Grass Valley around Leach Hot Springs revealed moderate microearthquake activity on a trend crossing the southern end of the valley, with occasional swarms in the area of high heat flow (4 to 6 hfu) at the north end of the 1915 Pleasant Valley earthquake (mag = 7.5) fault trace. Studies in The Geysers steam field reveal significant velocity and attenuation anomalies associated with the production zone. It is concluded that with proper sampling in space and time, P- and S-wave velocity and attenuation data can detect and delineate significant anomalies associated with the static properties of a geothermal resource. Microearthquake data are useful for monitoring the dynamic strain relief processes associated with fluid movement, temperature and pressure gradients in geothermal environments.

54874 (NP—23235) **Studies on wide-area deep geothermal resources. A collection of outlines of results on Sunshine Project.** (Geological Survey of Japan, Kawasaki, Kanagawa). Apr 1977. 9p. (In Japanese). TIC.

The results of studies of geothermal exploration techniques are reported. The techniques included artificial magnetotellurics, thermal balance calculation, seismic bright-spot analysis, remote sensing via LANDSAT/ERTS, and various geochemical and petrologic analytical techniques. Emphasis was placed on improving natural magnetotelluric techniques and reducing signal noise in the artificial method. Stable operation of the magnetometer was achieved. The bright-spot technique was improved by the incorporation of reflected-wave data. A precise analysis of concentric ring structures at the Hachimantai geothermal field was performed using LANDSAT and ERTS images. A new metering device was developed which enables the determination of thermal conductivity under high temperature conditions. Studies of the alteration characteristics of rocks at the Tamagawa field also yielded fruitful results.

54875 (NP—23236) **R and D of methods for surveying extensive geothermal structures. A collection of outlines of results on Sunshine Project, geothermal energy.** (Geological Survey of Japan, Kawasaki, Kanagawa). Apr 1977. 9p. (In Japanese). TIC.

Hachimantai geothermal field was chosen as a study area for the development or refinement of geothermal surveying techniques. Studies were made of soil temperature, thermal flow, hydrothermal alteration, and microearthquake activity. During the course of the studies, a topographic map, a gravity survey map, an aerial magnetic prospecting map, and a geological map were prepared. These maps, when correlated, show the scale and depth of geothermal resources, the relationship between structure and temperature, modes of propagation, and permit estimation of the quantity of geothermal fluid present. During 1975, one 500 m borehole and thirty 100 m boreholes were sunk. The soil temperature and temperature gradient were determined at 10 m intervals. There are areas with temperatures in excess of 500°C distributed along a traverse of about 200 km, along the Kitamata River southeast of the Tohichi hot spring, and also throughout a wide area bounded by the Sumikawa, Onuma, and Toroko hot springs. In the 500 m borehole, the maximum temperature was 109.6°C at about 274 m. The geothermal map shows that at a depth of about 80 m, the heat flow is about 20 HFU (837.4 mW/m_2) in the area of the Onuma power plant and in the Tohichi hot spring area.

54876 (NP—23240) **Heat flow, radiogenic heat production, and crustal temperatures in England and Wales.** Richardson, S.W.; Oxburgh, E.R. (Oxford Univ. (UK). Dept. of Geology and Mineralogy). 1977. 40p. Dep. NTIS (US Sales Only), PC A03/MF A01.

New heat flow values for 31 sites in England and Wales are reported. For 14 sites, thermal conductivities of samples were determined and temperature gradients measured over several hundred meters were used to calculate reliable heat flow values. For the other 17 sites, conductivities were estimated from stratigraphic logs. Based on a total of 40 sites, the average heat flow for the area was determined to be 1.4 HFU. The Lincolnshire sedimentary basin may have a slightly higher than average heat flow, and temperatures may reach more than a 100°C below about 3.0 km. There is a linear correlation between surface heat flow and heat production in local granitic or metasedimentary basement penetrated by 10 boreholes. The intercept of the dependence was 0.56 plus or minus 0.07 HFU. The high slope (16.0 plus or minus 1.6 km, as compared with 5.0—11.0 km for other areas) is believed to reflect the nature of late Pre-Cambrian, and Lower and Upper Paleozoic regional tectonics. Sixty-four references are provided.

54877 (UCRL—80974) **Monitoring natural subsidence and seismicity in the Imperial Valley as a basis for evaluating potential impacts of geothermal production.** Crow, N.B.; Kasamayer, P.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Apr 1978. Contract W-7405-ENG-48. 5p. (CONF-780708—14). Dep. NTIS, MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

Portions of document are illegible.

Results of work done on potential geologic effects of geothermal development are discussed. The key geological issues in the Imperial Valley are the potential for significant subsidence and seismicity which could be induced by geothermal production. The major technical problem is to develop techniques to distinguish between natural and induced activity. In both subsidence and seismicity studies, the projects augment the existing network to obtain additional information in critical areas; thus, local subsidence detection networks were added to the regional networks. The U.S. Geological Survey seismograph network was augmented to increase sensitivity to small earthquakes near the Salton Sea. Techniques being used and initial results are summarized briefly. (JGB)

54878 **Measurements of heat discharge at Owakudani geothermal area, Hakone Volcano, Japan.** Sekioka, M. (Inst. of Meteorology, Yokosuka, Japan); Itoh, Y.; Saitoh, T.; Ohba, M.; Takahashi, K. *J. Jpn. Geotherm. Energy Assoc.;* **15**: No. 1, 11-18(Mar 1978). (In Japanese).

Surface temperatures at the A region of Owakudani geothermal area Hakone volcano, Japan, were measured on 29 July 1977 to compare with the previous observations by using PANA-THERMO. PANA-THERMO is an infrared radiation camera with the built-in pyroelectric target scanned electronically for displaying of two-dimensional infrared thermal images. The camera makes it possible to continue field observations about five hours with each Pb battery. After enhancement of their signal-to-noise ratio by the technique of random access memory, thermal images are processed digitally to obtain 8-stage colored isothermal patterns. A relation $\Delta G = K\Delta\text{theta}$ between distributions of surface temperature (theta) and of heat discharge (G) which was derived from the heat budget equation for geothermal areas requires the value of K to convert isotherms to isopleths of heat discharge. The round-off mean value of K 800, is adopted from the several values in the previous papers, without extra observations for determining of K. Comparison of the heat discharge pattern obtained by PANA-THERMO measurement with those by the methods of snowfall calorimetry (5 to 8 March 1970), by the infrared radiation thermometer (2 April 1972), and by the infrared radiation thermocamera (6 April 1974) shows a fairly good coincidental tendency, especially with that of the radiation

thermocamera in the two-dimensional thermographic mode similar to PANA-THERMO, though the absolute values have differences in two or three factors at maximum. The foregoing matters indicate that heat discharge from the A-region did not experience large variation during the past seven years. Possible adoption of the constant value of K may give an advantage for estimation of heat discharge at geothermal areas with a relation $\Delta G = K\Delta theta$ by remote sensing of surface temperatures in spite of about 20%-error content.

GEOCHEMICAL TECHNIQUES AND SURVEYS

54879 (CONF-7610123—2) **Alkaline mineral hot spring as an example for water—rock interactions.** Ikkoku, M.; Suzuki, R. (Geochemical Society of Japan, Tokyo). 1975. 1p. (In Japanese). TIC.

From Annual meeting of the Geochemical Society of Japan; Nagoya, Japan (25 Oct 1976).

Portions of document are illegible.

In the Abukuma mountain area there are several dislocations or faults and several hot springs located on them. In such a geological structure surface water circulates deeply into the Earth and remains in contact with the rocks for extended periods. Consequently, the hot springs in this area can be considered to be in equilibrium condiions. This type of hot spring water tends to have a high pH value. Using the equation $\log k = \log ({}_5Ca \text{ ion}/{}_5H \text{ ion}^{\,2}) + 8 \log {}_5Si(OH)_4$ the data were analyzed. The value of log k was calculated to be -11.0 for the hot spring water, pH was greater than 9. This differs considerably from earlier values and shows that the situation is one of equilibrium.

54880 (PB—276399) **Assessment of the characterization (in situ-downhole) of geothermal brines. Final report.** (National Materials Advisory Board (NRC), Washington, DC (USA)). Jan 1978. Contract E(49-18)-2551. 74p. (NMAB—344). NTIS PC A04/MF A01.

Characterization of geothermal brines is complicated because of the extreme down-hole conditions of temperature, pressure, corrosivity, and flow rate; the difficulty in placing and retrieving sensors and instrumental packages deep in the wells; and the diminished value of measurements on 'dead' (stagnant) fluid that is taken out of the well for characterization. The scope of the present study includes: (1) Determination of the important physical and chemical properties which characterize geothermal brines, and the instrumentation which can be used to obtain these properties; (2) A review of the current state of the knowledge of instruments and their materials of construction which can be operated under in situ conditions in geothermal wells; (3) Assessment of the priorities of development of new instrumentation which can be used to characterize in situ brines; and (4) Making of recommendations for additional research on instruments related to certain specific measurements.

EXPLORATORY DRILLING AND WELL LOGGING

REFER ALSO TO CITATION(S) 54869

54881 (NVO—194) **Geopressured-geothermal drilling and testing plan. General Crude Oil—Dept. of Energy Pleasant Bayou No. 1 well, Brazoria County, Texas.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). May 1978. 102p. Dep. NTIS, PC A06/MF A01.

As a result of geopressured resource assessment studies in the Gulf Coast region, the Brazoria fairway, located in Brazoria County, Texas was determined to be an optimum area for additional studies. A plan is presented for drilling, completion, and testing of one geopressured-geothermal well and two disposal wells in Brazoria County, Texas. The objectives of the well drilling and testing program are to determine the following parameters: reservoir permeability, porosity, thickness, rock material properties, depth, temperature, and pressure; reservoir fluid content, specific gravity, resistivity, viscosity, and hydrocarbons in solution; reservoir fluid production rates, pressure, temperature, production decline, and pressure decline; geopressured well and surface equipment design requirements for high-volume production and possible sand production; specific equipment design for surface operations, hydrocarbons distribution, and effluent disposal; and possibilities of reservoir compaction and/or surface subsidence. (JGB)

LEGAL AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 55322, 55323

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

54882 (LA—7307-MS) **Water quality in vicinity of Fenton Hill Site, 1976.** Purtymun, W.D.; Adams, W.H.; Stoker, A.K. (Los Alamos Scientific Lab., NM (USA)). May 1978. Contract W-7405-ENG-36. 19p. Dep. NTIS, PC A02/MF A01.

Water quality data have been collected at 9 surface-water stations, 11 ground-water stations, and 3 ponds at the Fenton Hill Geothermal Site in the Jemez Mountains. This is part of the Los Alamos Scientific Laboratory's continuing program of environmental studies. Insignificant changes (within expected normal seasonal fluctuations) in the chemical quality of water at individual stations were observed during the year. Predominant ions and total dissolved solids remained essentially stable.

54883 (UCRL—81177) **Chemical fingerprints to assess the effects of geothermal development on water quality in Imperial Valley.** Pimentel, K.D.; Ireland, R.R.; Tompkins, G.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Apr 1978. Contract W-7405-ENG-48. 5p. (CONF-780708—16). Dep. NTIS, PC A02/MF A01.

From Geothermal Resources Council meeting; Hilo, HI, USA (25 Jul 1978).

A two-year baseline water quality study was conducted in the Imperial Valley. The data accumulated, together with the drinking and irrigation water criteria and the known costs of chemical analyses, augment findings on brine chemistry throughout the Valley and on constituents in the Vail 4A Drain, an agricultural drain in the Salton Sea KGRA. These suggest minimum parameters that should be monitored in future programs for water quality management during the development of the geothermal resources in Imperial Valley. They are concentrations of B, Li, Mn, Zn, Na, K, Ca, Mg, Cl, SO_4, CO_3, and HCO_3, TDS, SC, pH, and temperature. Arsenic, Se, Pb, and Ni should also be considered in the future because of their possible elevation in some brines above existing water quality criteria. (JGB)

GEOTHERMAL POWER PLANTS

DESIGN AND OPERATION

54884 (CONF-780641—1) **Raft River 5MW Geothermal Pilot Plant.** Whitbeck, J.F.; Piscitella, R.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 1978. Contract EY-76-C-07-1570. 6p. Dep. NTIS, PC A02/MF A01.

From 2. geothermal conference; Taos, NM, USA (20 Jun 1978).

Elements of design of the 5 MW(e) binary cycle plant to be built in the Raft River Valley in Idaho are discussed. Advantages of the dual boiling cycle for use with moderate temperature (250 to 350°F) resources are discussed. A breakdown of the heat loads and power requirements is presented. Various components, including pumps, heat exchangers, cooling tower, turbine-generators, and production and injection systems, are described. (JGB)

POWER PLANT SYSTEMS AND COMPONENTS

54885 (SAN—1076-1) **Theory and practice of near critical pressure direct contact heat exchange. Final report.** Wahl, E.F.; Boucher, F.B. (Occidental Research Corp., La Verne, CA (USA)). Oct 1977. Contract EY-76-C-03-1076. 243p. Dep. NTIS, PC A11/MF A01.

The direct contact heat exchange (DCHE) system previously designed, developed, and tested, was operated successfully without scale deposition. Conceptual design, optimization, and cost analysis showed that an additional advantage is the reduction in cost due to the high capacity of the DCHE compared with conventional heat exchangers. The technical and economic feasibility of DCHE operated near or above the critical pressure of isobutane using isobutane in direct contact with geothermal brine was assessed. The program consisted of conceptual design with a preliminary process evaluation and feasibility analysis, design and construction of the experimental apparatus, experimental tests, a final revised process evaluation and feasibility analysis based on the experimental results, and preparation of a design procedure. No scaling problems were present in the direct contact heat exchanger or the test unit. Test runs show that no scale was deposited in either the packed column section or the sieve tray section for continuous runs of 76 and 160 hours using East Mesa well 6-2 brine. In fact, the sieve tray section after 160 hours operation was visibly cleaner after the run than before. Both the packed column section and the sieve tray section operated according to theoretical thermodynamic and hydraulic predictions. Operation of the supercritical isobutane direct contact heat exchange and associated test unit with geothermal brine was routine with automatic controls and without operator attention. A design procedure includ-

ing the requisite equations for sieve tray direct contact heat exchange columns was developed. The procedure gives the optimum ratio of isobutane to brine, optimum number of trays and tray spacing, and the sieve tray layout variables, namely downcomer area, active hole area, bubbling area, and column cross sectional area.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

54886 (SAND—78-1063C) **Geothermal Well Technology Program.** Varnado, S.G. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 8p. (CONF-780580—1). Dep. NTIS, MF A01.

From Workshop on geothermal drilling fluids; Houston, TX, USA (23 May 1978).

Portions of document are illegible.

The high cost of drilling and completing geothermal wells is an impediment to the development of geothermal energy resources. Technological deficiencies in rotary drilling techniques are evidenced when drilling geothermal wells. The Division of Geothermal Energy (DGE) of the U.S. Department of Energy has initiated a program aimed at developing new drilling and completion techniques for geothermal wells. The goals of this program are to reduce well costs by 25% by 1982 and by 50% by 1986. An overview of the program is presented. Program justification which relates well cost to busbar energy cost and to DGE power-on-line goals is presented. Technological deficiencies encountered when current rotary drilling techniques are used for geothermal wells are discussed. A program for correcting these deficiencies is described.

54887 (SAND—78-1064C) **Portable high temperature, high pressure viscometer.** Reineke, R.C.; Varnado, S.G. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 15p. (CONF-780580—2). Dep. NTIS, MF A01.

From Workshop on geothermal drilling fluids; Houston, TX, USA (23 May 1978).

Portions of document are illegible.

A field instrument for measuring the rheological characteristics of drilling mud at simulated downhole conditions was developed. The instrument can provide viscosity measurement to 300 centipoise at temperatures up to 500°F, pressures up to 12,500 psi, and shear rates up to 1000 Hz. The design of the system is described, and the results of some preliminary tests on water-based and oil-based drilling muds are given. The design consists of a rotational viscometer packaged inside a heated pressure vessel. The fluid sample is placed inside a test cell, and the desired temperatures and pressure conditions are then selected. A direct readout of viscosity is provided. Four samples of water-based muds were tested: a bentonite mud, a bentonite mud with FCL thinner, a bentonite based mud with FCL and lignite thinners, and a mud developed by Maurer Engineering for geothermal use. Tests on these muds indicate that the addition of thinners is effective in increasing the usable temperature range of the bentonite mud from approximately 125°C to 200°C. Pressure effects on water-based muds were found to be insignificant. Oil-based muds exhibited thinning characteristics with increasing temperature and a marked increase in viscosity with increased pressure. Therefore, during drilling, the borehole pressure tends to compensate for the thinning effect of borehole temperature. Curves showing this quantitative dependence of viscosity on temperature and pressure are presented.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

REFER ALSO TO CITATION(S) 54881

DIRECT ENERGY UTILIZATION

54888 (NP—23238) **Studies of agricultural air conditioning system using geothermy.** Ishibashi, S.; Tanaka, S. (Kagoshima Univ. (Japan)). 1977. 17p. (In Japanese). TIC.

A geothermally cooled greenhouse was manufactured for experimental purposes. It was installed at Yamakawa-cho (Yushuku gun), where geothermal hot water is produced at 106°C. The cooling unit is of the absorption type, with a cooling power of 6 Mcal/h. Calculations showed that the greenhouse load was about 4.5 Mcal/h. All components of the unit performed as expected. The harvesting times were optimized for spinach (40 days), head lettuce (80 to 100 days), and peas (80 days).

54889 (NP—23239) **Fundamental studies of heat exchange facilities for plant gardening using hot water.** Ishibata, K.; Arita, S.; Irida, S.; Kukitomi, K. (Kagoshima Univ. (Japan)). 1977. 18p. (In Japanese). TIC.

During the course of a geothermal greenhouse development program, two heat exchangers for hot spring water were experimentally manufactured. The first of these exchangers was equipped with a condenser having a 38.19 cm^2 surface area and a 400 W fan. The second was an aerofin tube having a 51.28 cm^2 radiating area and a 150 W fan. A greenhouse with a floor area of 155 to 183 m^2 was used in the testing. Results indicate that the greenhouse could be raised to 10°C above the outside temperature even at the lowest ambient winter temperature. The overall heat transmission coefficient of the first exchanger was 24.57 kcal/m^2/°C. The coefficient for the second was 23.53 kcal/m^2/°C. In tests with watermelons and flowering plants, including mangos, normal growth occurred and marketable produce was obtained. The use of these geothermal heat exchangers resulted in a heating cost which was less than $^1/_{90}$th that of class-A fuel oil (hot-air) furnaces.

54890 **Proposal of a regulation (EEC) of the Council for the application of the regulation of the Council on granting financial support for projects utilizing alternative energy sources in the field of geothermal heat. Information by the Federal Government.** *Bundesrat - Drucksache;* No. 190, 1-6(Apr 1978). (In German).

GEOTHERMAL DATA AND THEORY

PROPERTIES OF AQUEOUS SOLUTIONS

54891 **Thermodynamics properties of the coexisting phases and thermochemical properties of the NaCl component in boiling NaCl solutions.** Haas, J.L. Jr. *U.S., Geol. Surv., Bull.;* No. 1421-B, B1-B71(Dec 1976).

Preliminary steam tables that give the thermodynamic data for the coexisting liquid and gas and that give the thermochemical data for the NaCl component in the liquid for the system H_2O—NaCl are given for liquid concentrations between 0 mol NaCl/kg H_2O and halite saturation at temperatures between 80° and 325°C. The tables were calculated from parametric equation of state.

ROCK-WATER-GAS INTERACTIONS

54892 **Hydrothermal alteration of basalts from Hawaii Geothermal Project Well-A, Kilauea, Hawaii.** Stone, C.; Fan, P.F. (Hawaii Inst. of Geophysics, Honolulu). *Geology;* 6: No. 7, 401-404(Jul 1978).

Mineralogical examination of basaltic rocks obtained during drilling of a successful 1,962-m-deep geothermal well (HGP-A) in the east rift zone of Kilauea Volcano, Hawaii, reveals three zones of hydrothermal alteration beneath a zone of unaltered lavas. Each alteration zone is characterized by the dominance of a particular mineral: zone 1, montmorillonite; zone 2, chlorite; zone 3, actinolite. Three zones of relative permeability can be tentatively identified on the basis of filled versus partly filled vesicles and fractures. Because the well has not returned to thermal equilibrium as of this writing, stability relations between secondary minerals and temperatures cannot be calculated with accuracy. However, the latest downhole temperatures measured at the boundaries of alteration zones, compared with similar data from high-temperature geothermal areas in Iceland, indicate that HGP-A temperatures are considerably higher than those encountered for the same alteration-zone boundaries in Icelandic wells. This indicates that the present-day thermal regime in HGP-A is relatively young and that the hydrothermal minerals probably have not reached equilibrium with existing conditions.

TIDAL POWER

TIDAL POWER PLANTS

POWER CONVERSION SYSTEMS

54893 **Large bulb units for tidal powerplants.** Casacci, S. (Societe Neyrpic, Grenoble, France). *Int. Water Power Dam Constr.;* 30: No. 7, 47-50(Jul 1978).

Experience gained at La Rance tidal power project suggests a number of ways of achieving design economies including the manufacture of bulb units with larger runner diameters than those now operating.

WAVE ENERGY CONVERTERS

54894 Hydroelectric plant. Garza, R.M. US Patent 4,092,828. 6 Jun 1978. Filed date 18 Jul 1977. 10p.

A hydroelectric plant operated by wave action is supported by the ocean floor and extends above the surface of the ocean. Connected to an outer edge of the plant structure above the surface of the ocean is a plurality of pivotally connected lever arms having floats connected on the ends thereof. The floats rise and fall with the ocean waves to cause pivotal motion of the lever arms. The lever arms connect through an adjustable crosshead and hydraulic cylinder to secondary levers. The secondary levers are pivotally attached to the plant structure and operate pump rods to move pistons the same stroke length regardless of the tide or the height of the waves. The movement of the piston may be used to pump water through a turbine, or to pressurize air, either of which may be used as a driving force for generating power.

WIND ENERGY

REFER ALSO TO CITATION(S) 54823, 54824

ECONOMICS

54895 (COO—2618-1) **Application of wind power systems to the Service Area of the Minnesota Power and Light Company. Final report, July 1975—August 1976.** Lindquist, O.H.; Malver, F.S. (Honeywell, Inc., Minneapolis, MN (USA). Systems and Research Center). 1976. Contract EY-76-C-02-2618. 359p. Dep. NTIS, PC A16/MF A01.

Honeywell, in a joint effort with Minnesota Power and Light Company (MP and L), Boeing Vertol Company, and Dr. C.G. Justus, Georgia Institute of Technology, has conducted a regional application study of wind energy systems. Minnesota Power and Light Company, an investor-owned company with 853-MW owned capacity, has served as the case study subject utility. An initial system definition was developed based on available wind information and near-term wind turbine generator (WTG) technology. The system was tailored to fit MP and L's forecasted generation needs and the company's existing transmission and distribution system. Honeywell developed a WECS simulation to convert wind data to wind energy available for input to the utility's grid. The simulation was used to evaluate the performance of preliminary design wind turbine generators developed for ERDA/NASA by the General Electric Company and Kaman Aerospace Corporation, and to evaluate the performance of a wind turbine optimized for the Northern Minnesota wind regime and developed by the Boeing Vertol Company under subcontract to Honeywell.

ENVIRONMENTAL ASPECTS

54896 (DOE/EIS—0006) **Wind turbine generator system, Block Island, Rhode Island. Final environmental impact statement.** (Department of Energy, Washington, DC (USA)). Jul 1978. 153p. Dep. NTIS, PC E03/MF E03.

Information on the environmental impacts of a Mod-0A wind turbine on Block Island, Rhode Island is presented concerning description of the proposed action; characteristics of the existing environment; potential environmental impacts; unavoidable adverse environmental impacts; alternatives; relationship between short-term uses and long-term productivity; relationship of the proposed action to land use plans, policies, and controls; irreversible and irretrievable commitment of resources; and environmental trade-off analysis.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 55305

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 55315, 55317

54897 (AD-A—050169) **Evaluation of instrumentation for testing large generator sets. Special report.** Ford, W.D.; Pollock, M.J. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Feb 1978. 47p. (CERL-SR-E—121). NTIS PC A03/MF A01.

This report, which supplements CERL Special Report E-103, presents the results of an investigation of instrumentation for use in measuring and recording voltage and frequency changes during performance testing of large engine-generator sets intended for stationary electric power generation service in fixed military facilities. Based on analysis of (1) the specific characteristics needed to fulfill the end use for which the electric power will be produced and (2) the instrumentation currently described in MIL-HDBK-705B, inadequate instrumentation, primarily that used for transient measurement, was selected for replacement by advanced instrumentation. Five advanced instrumentation systems were selected for field testing based on their suitability for field testing, their recording capability, and their capability to measure in the desired range. The system which performed best in the field testing was the Gould 2200 Recorder. It is recommended that this recorder system, supplemented by a Dranetz line monitor to prevent accuracy problems caused by the Gould system's dependence on paper slip and pen width, be used for testing utility-grade and medium-grade power systems. Testing of precision-grade systems would require use of a transient digitizer system with subsequent computer analysis of the data.

54898 (EPRI-NP—759-WS) **Proceedings: workshop on EPRI availability engineering.** Long, R.L.; Cleveland, E.B.; Stiehl, G.L. Jr. (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1978. 249p. (CONF-7710147—). Dep. NTIS, PC A11/MF A01.

From Workshop on EPRI availability engineering; Albuquerque, NM, USA (17 Oct 1977).

The proceedings of the EPRI Availability Engineering Workshop, held in Albuquerque, New Mexico, October 17 to 19, 1977 are recorded. The workshop evolved out of an EPRI-sponsored, eight-month study by Holmes and Narver, Inc., titled, "Assessment of Methods for Implementing Availability Engineering in Electric Power Plants," EPRI Report NP-493, May, 1977. Availability engineering methods, implementation, and experience are discussed.

54899 (FE—1726-40) **Engineer, design, construct, test, and evaluate a pressurized fluidized bed pilot plant using high sulfur coal for production of electric power. Phase II pilot plant design. Pilot plant configuration report.** (Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.). Oct 1977. Contract EX-76-C-01-1726. 26p. Dep. NTIS, PC A03/MF A01.

The configuration selected for the application of the pressurized fluidized bed (PFB) process for direct combustion of high sulfur coal (greater than or equal to 3%) in a combined gas turbine/steam turbine cycle includes: (a) gas turbines to provide compressed air for coal combustion ($^1/_3$ of the airflow) and air cooling in the PFB heat exchanger ($^2/_3$ of the airflow); (b) recombination of the total compressor airflow after heating for expansion in the compressor drive turbine and further expansion in a power turbine which drives an alternator; (c) gas turbine waste heat recovery in a steam boiler which powers a steam turbine/alternator. The selected configuration limits the hot gas flow which must be passed through a particulate clean-up system to approximately $^1/_3$ of the total gas turbine flow and reduces the concentration of corrosive combustion products in the recombined turbine gas steam to $^1/_3$ of the concentration which exists in the combustion gas exiting the PFB. The PFB Pilot Plant design incorporates an existing power plant with considerable utilization of currently operating equipment. The basic equipment and functions are listed: coal and sorbent unloading and storage systems, coal sizing and drying system, coal and sorbent feed system, remote start-up combustors liquid or gas fuel fired, PFB combustor with ash handling equipment, combustor bed heat exchange system, gas cleaning systems, combustion and cooling air compressor and turbine, gas turbin alternator drive, alternator and switch gear, waste heat recovery boiler, and a computerized control system.

54900 New possibilities for electricity generation and use. Tombs, F. *Heat. Vent. Eng.;* **52**: No. 609, 10-11(Jun 1978).

A brief discussion of possible future developments in the electric power industry is given. Topics discussed include energy storage systems, fluidized bed combustion, thermonuclear islands, heat losses in houses, and energy losses in power generation. (PMA)

54901 Amendment of the guidelines concerning Section 3 Subsection 4 of the Third Electricity Generating Act dated May 8th, 1978. *Bundesanzeiger;* **30**: No. 95, 2(May 1978). (In German).

54902 Industrial power plant with unified process control. Goebelbecker, T.; Pfisterer, E.; Watzka, M. *BBC-Nachr.;* **60**: No. 1, 43-48(1978). (In German).

The article provides information on the power plant process control system Procontrol, using the process control equipment of the Hamborn industrial power plant, unit 4, (blast-furnace gas and coke-oven gas fired) as a basis. Tasks and set-up of this power plant as well as the unified process control equipment with its special

features are briefly explained. BBC, who completed the overall planning and delivered the measuring, digital and analog control and fault-signal logging equipment as well as the turbo-set, could hand over the system to Thyssen AG in the autumn of 1976.

54903 Modernizing and increasing the output of a power plant. Czerwinski, R.; Rapp, H. *BBC-Nachr.;* **59**: No. 12, 499-506(1977). (In German).

The aim was to modernize and expand the Elverlingsen power station of Elektromark AG. BBC solved this problem in less than two years, by constructing a turnkey gas turbine power station with two gas turbo sets 13 D and two waste-heat boilers. In this connection BBC pursued and realized goals, such as increase in output, low heat consumption, quick start-up and shutdown, easy operation by means of automation, minimal capital costs and low environmental pollution.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 54255, 55747

54904 (K/CSD/INF—77/1(Rev.1)) **Computerized engineering model for evaporative water cooling towers.** Park, J.E.; Vance, J.M.; Cross, K.E.; Van Wie, N.H. (Union Carbide Corp., Oak Ridge, TN (USA). Computer Sciences Div.). 1978. Contract EY-76-C-02-0016. 7p. (CONF-780805—6). Dep. NTIS, PC A02/MF A01.

From 6. heat transfer conference; Toronto, Canada (7 Aug 1978).

The evaporative cooling tower is often used to reject waste heat from industrial processes, especially power plants and chemical facilities. In particular, huge cooling towers are used for heat rejection from gaseous diffusion plants. The ability to analyze and/or predict the performance of these towers is an important process engineering function. A consistent physical model for crossflow and counterflow cooling towers is presented, which imposes rigorous heat and mass balances on each increment of the tower under study. Individual towers are characterized by specification of a mass evaporation rate equation. Water evaporation rates and temperatures are calculated for each increment. The discretization of the rate and balance equations is accurate to second order in the space variables. Computational evidence of this property is presented for both counterflow and crossflow cooling towers. The solution algorithm is described. Calculated profiles of air temperature, water temperature and evaporation rate within a counterflow and a crossflow tower are presented. Using a computer, the model allows reduction of test data, interpolation of the reduced data and comparison of test results to design data. These capabilities can be used to evaluate acceptance tests for new towers, to monitor changes in tower performance as an aid in planning maintenance, and to predict tower performance under changed operating conditions.

54905 Convergent design of the top of large round cooling towers interacting with an upward-spraying water distribution. Ruehl, H. (GEA-Gesellschaft fuer Luftkondensation m.b.H., Bochum (Germany, F.R.)). *VGB Kraftwerkstech.;* **58**: No. 4, 289-297(Apr 1978). (In German).

From VGB congress on power plants and VGB annual general meeting; Copenhagen, Denmark (30 Aug - 2 Sep 1977).

The article reports on the wind influence and in-rush of cold air at the top region of large round cooling towers and, by the example of studies in the model of a round cooling tower with natural draft, scale 1 : 100 (base dia. 138 m, total height 152 m), shows the possibilities of improved shape of the top in convergent design. The application of convergent shape for the top leads to more favourable dimensions and a more efficient way of operation of the cooling towers. The result of the studies on droplet size and distribution of rain density in the range of the sprayer for upward-directed water distribution is illustrated. The water distribution spraying upwards, having been studied on operating plants, is indicated in its interaction with the convergently designed top.

54906 First operational experiences with a wet/dry-type experimental cooling tower in BASF. Kokott, D. (BASF A.G., Ludwigshafen am Rhein (Germany, F.R.)). *VGB Kraftwerkstech.;* **58**: No. 4, 282-289(Apr 1978). (In German).

The experiments have shown that the formation of visible clouds in the proximity of cooling towers can be prevented by the use of wet/dry-type cooling towers. On account of its small size, the tested pilot plant gave no results on the meterological effects in the far range of influence of the cooling tower. By improvements of the geometrical configuration and design of the dry-cooling elements a solution of the fouling problem may be expected as well as k numbers from 40 to 50 W/m^2 K. Therefore, plastic materials, also with respect to thermal engineering, are an interesting alternative to metallic materials for the dry part. The experiments will be continued with vertically arranged flow channels in the dry part and with parallel connection on the air side and connection in series on the water side as a method of operation.

54907 M.A.N. cooling elements - reversal of principle increases performance. Heeren, H. *M.A.N. (Maschinenfabr. Augsb.-Nuernb.) Forsch., Planen, Bauen;* No. 9, 20-24(1978). (In German).

The principle of dry cooling systems developed by M.A.N., in particular the 'LRT' element which uses air instead of water, is described.

54908 Cooling tower. Zerna, W.; Schultz, H. German(FRG) Patent 2,614,695/A/. 20 Oct 1977. 13p. (In German).

The proposal concerns the reinforcement of a cooling tower made of reinforced concrete, which has a dish-shaped supporting structure and has ribs running in the vertical direction. In order to reduce the cost for fitting the reinforcement, the dish-shaped supporting structure is made wholly or partly as an anisotropic dish. By this construction of the reinforcement (spatial grating with different thickness of beam reinforcement of vertical ribs and of the circular beams provided in the dish, site reinforcement of the areas between the beams) one achieves the anisotropy of the dish. The fixing of constructional steel mats as site reinforcement is advantageous.

54909 Merkel coefficient and its dependence on the temperature position of the cooling tower process. Klenke, W. *Brennst.-Waerme-Kraft;* **29**: No. 10, 400-409(Oct 1977). (In German).

The Merkel coefficient, or evaporation coefficient, is still being used as a characteristic factor for the cooling tower process. Its dependence on the cooling range or on the warm water temperature of the process is often considered a disadvantage of the theory of evaporation cooling. This is also the reason for the suggestion to change the theory in such a way that the Merkel coefficient becomes independent of the temperature. The present investigation, however, leads to the result that the dependence of the Merkel coefficient on the temperature must be considered as a remarkable confirmation for the evidence of the theory of heat and mass transfer, as the experimental statements agree fully with the results of the theoretical considerations.

54910 Contact bodies for water and air for cooling towers. Meek, G.W. (to Aktiebolaget Carl Munters). German(FRG) Patent 2,234,013/B/. 12 May 1977. 2p. (In German).

Cooling towers have contact bodies for water and air in the form of waves or folded plastic layers. In order to avoid damaging of the layer edges, it is suggested according to the invention, that a strengthened edge be made by folding over the edge of the plastic layer before waving or folding. This may be easily mass-produced. The contact bodies are then put together into the desired layers directly in the cooling tower.

54911 Device for noise-abatement in a cooling tower. Baer, E.; Dittrich, H.; Ernst, G.; Roller, W.; Wurz, D. German(FRG) Patent 2,547,719/A/. 28 Apr 1977. 15p. (In German).

This device attenuates the noise of cooling water droplets falling out of trickling plates below a spray facility. In this manner expensive noise-attenuating cranks or embankments around the cooling tower become unnecessary. Noise attenuation is achieved by a catching device located closely above the water reservoir. Instead of falling vertically on the water surface, the droplets hit the inclined surfaces of a horizontal grid. A number of such plane or slightly curved surfaces are placed together with little inclination against the vertical (25° to 30°, with a maximum of 45°) at such a distance that no drop can hit the water surface directly, i.e. unattenuated. In a second type of design also the capacity of the cooling water pumps and with it the investment and operating cost is reduced. For instance, about 2000 kW are saved by higher arrangement of the catching device, closely below the trickling components.

54912 Intake structure for cooling water of power plants. Koeth, D. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,624,548/B/. 17 Mar 1977. 3p. (In German).

This type of construction for taking cooling water for a power plant from a river is planned to offer effective protection against sabotage. By possible construction of several parallel units attacks with bombs, bursting charges, or plastic foamers do not effect the operation of the power plant. For this purpose the cooling water is not directly taken from the river by means of an extraction channel but through the intermediary of an intake channel running at right angles to it and parallel to the river. These two channels and a drum screen connected between them lie with their center and axis of symmetry in a common horizontal plane and so far below the level of river and bank that nothing can be seen from the outside. The water intake channel is running parallel to the river for a short distance to the river bank. The inlet and outlet to the river lie below the water surface. The channel has got an upright rectangular cross-section that gets larger in the flow direction by continuous, gradual increase of height. The extraction channel leading to the power plant

has a constant rectangular cross-section that opens perpendicularly into the first channel. At short distance from this mouth the cross-section of the extraction channel is filled by a drum screen moved on a vertical axis by a geared engine.

54913 Top of a cooling tower. Baer, E.; Wurz, D.; Ernst, G. German(FRG) Patent 2,535,492/A/. 10 Feb 1977. 11p. (In German).

This is a supplement to DP 24 14 172.8 which refers to air slightly in motion, aiming at an improvement of the efficiency of a cooling tower, with the result that the tower's height can be reduced while keeping up to the same capacity by means of partially lateral screening against mean and major wind velocities. This screening, which can easily be arranged onto and removed from any peripheral section of the cooling tower, is to prevent the upper cooling tower openings to be closed by side-winds passing over them. A pylon in the centre of the cooling tower overlooks its upper edge by several meters. Ropes stretched from the pylon's top to the upper tower periphery form a pyramidal pole. Its lower part may be covered with fabrics and plastics as a screening, stretching from one rope to another. When all areas are covered they form a closed truncated cone tapering the cooling tower upwards. According to the master patent, they prevent cold air from entering the cooling tower with air slightly in motion. According to the supplement, the screening is rolled up at the side sheltered from the wind when there are major wind velocities. That part remaining at the windward side diverts the wind upwards and waste steam can escape freely on all sides. A control mechanism individually powered for rolling the (plastic or) fabric coverings is described.

POWER CYCLES

REFER ALSO TO CITATION(S) 54920

54914 (FE—1806-25) **Low-Btu fuel combined cycle reference design.** (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Jul 1977. Contract EX-76-C-01-1806. 345p. Dep. NTIS, PC A15/MF A01.

Portions of document are illegible.

This topical report, Sections 1 through 8, on the Baseline Design presents information for Case A, the Coal-Derived Gas Combined Cycle (CDG-CC) Plant. The report is organized to present an overall picture of the plant arrangement initially. It then describes separate parts of the plant starting with coal systems, fuel gas generation and cleaning, combined cycle power island arrangement, design of the high temperature gas turbine and control system, and plant control. In addition, information on failure mode analysis, plant costs, and power generation costs are included. For major plant parts System Design Descriptions (SDDs) are presented including the Fuels plant, the Gas Turbine system, and the Integrated Plant Control system. Since a detailed understanding of the gasifier is necessary to a full evaluation of the gas cleanup system, a detailed description of the fixed bed gasifier is also included. As indicated in the OPDD for Case A (with fixed bed gasifier), a choice was made to present Case A rather than Case B1 (with entrained bed gasifier) as the primary design for CDG-CC. Information relating to the Case B1 baseline design is presented in Section 9 of this report.

54915 (PB—277188) **High efficiency decentralized electrical power generation utilizing diesel engines coupled with organic working fluid rankine-cycle engines operating on diesel reject heat.** Morgan, D.T.; Davis, J.P. (Thermo Electron Corp., Waltham, MA (USA)). Nov 1974. 407p. (TE—4186-27-75). NTIS PC A18/MF A01.

A comprehensive study of high efficiency electrical power plants, consisting of diesel engines coupled with organic working fluid Rankine-cycle engines (ORCS) operating on the diesel exhaust heat is described. A combined cycle efficiency of 46.3 percent is attained with commercially available diesel engines with a potential for >50 percent using experimental engines. The estimated unit capital cost of a 50 Mwe diesel/ORCS power plant is $250/kwe. The use of small power plants is economically feasible, and is a way to reverse the current trend of centralization. Decentralization, coupled with high plant efficiency, would result in important advantages with respect to environmental effects, fuel conservation and effective land use. Conventional diesel and gas engines can be operated on distillate or residual fuel oil, natural gas, and products of coal gasification. (Color illustrations reproduced in black and white)

54916 Thermal power station combined with a plant for seawater desalination. Pfenninger, H. (to BBC Brown, Boveri and Company Ltd.). US Patent 4,094,747. 13 Jun 1978. Priority date 14 May 1976, Switzerland. 4p.

A combined thermal power station and a desalination plant for seawater are described in which the power station includes a gas turbine set, a waste heat boiler connected to the exhaust gas outlet of the gas turbine and a steam turbine. The waste heat boiler includes first and second sections arranged in cascade on the water side in the flow path of the turbine exhaust gases, the first section in the exhaust gas flow path consituting a steam in the exhaust gas flow path constituting a steam generator for the steam turbine and the second section constituting a source of heat utilized in the desalination plant. Seawater may be passed directly through the second section of the waste heat boiler or high-temperature hot water produced by the second section may be passed through a heat exchanger incorporated in the flow path of the seawater. The waste heat boiler may further include an additional source of heat in the form of a fuel burner for maintaining operation of the steam turbine and desalination plant under emergency conditions in the event the gas turbine set is stopped.

WASTE-FUELED SYSTEMS

REFER ALSO TO CITATION(S) 54815

COMPONENTS

REFER ALSO TO CITATION(S) 54914, 54916, 54938

54917 (FE—1806-9) **Development of high temperature turbine subsystem technology to a "technology readiness status": Phase I. Second quarterly report, October—December 1976.** Caruvana, A. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). 17 Jun 1977. Contract EX-76-C-01-1806. 325p. Dep. NTIS, PC A14/MF A01.

Two gasification systems, the advanced fixed bed and the entrained bed, have been evaluated and compared in order to select a single system for an Overall Plant Design Description (OPDD). Comparisons made to date favor the fixed bed system due to more favorable control characteristics, more experience, and a significantly higher overall plant thermal efficiency. Also selected for inclusion in the OPDD was the Benfield Acid Gas Removal System to be used for gas cleanup. Included herein are the results of parametric studies on the coal-derived liquid combined cycle plant. A Failure Mode and Effects Analysis has begun with Fault Tree preparation based on specific constraints. Design evaluations of various turbine cooling schemes and their influence on the balance-of-plant design plus development requirements are shown. The resulting prime turbine design of all water cooled nozzles and buckets is illustrated plus the backup design of water cooled nozzles and steam cooled buckets. Combustor design efforts are shown on the annular, sectoral, and cylindrical concepts. The mechanical assembly difficulties of the annular design and the flow separation problems of the cylindrical design are overcome by the sectoral design which is derived from annular combustor technology.

54918 (FE—1806-22) **Development of high temperature turbine subsystem technology to a "technology readiness status": Phase I. Final report.** Caruvana, A. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Jul 1977. Contract EX-76-C-01-1806. 576p. Dep. NTIS, PC A25/MF A01.

The primary objective of the Phase I ERDA High-Temperature Turbine Technology (HTTT) Program was to provide a "Program and System Definition" of the three-phase program which would culminate in the testing of a Technology Readiness Vehicle (TRV) at the end of a six-year period. The TRV is designed for use in a combined cycle using coal-derived fuels at a firing temperature of 2600°F; growth capability to 3000°F is projected. The Phase I results reported are based on a 2600°F gas turbine burning coal-derived fuels. The following major areas are covered: overall plant design descriptions; systems design descriptions; turbine subsystem design; combustor design; phase II proposed program; and phase III proposed program. Details regarding final results of each of these areas are presented. It is concluded that the water-cooled gas turbine in combined cycle has been shown to be capable of extremely attractive levels of performance, both in terms of efficiency and specific output. Coupled with the ability to tolerate a wide range of coal-derived fuels with minimum fuel treatment, an extremely attractive system is presented for the generation of electric power. Future technology development of the high-firing-temperature water-cooled gas turbine is expected to result in the commercial introduction of this concept in combined cycles by the late 1980's or early 1990's.

54919 (FE—1806-27) **High Temperature Technology Program. Reference turbine subsystem designs (primary and backup concepts).** (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Jul 1977. Contract EX-76-C-01-1806. 592p. Dep. NTIS, PC A25/MF A01.

The objective of the ERDA-HTTT Program is to bring to Technology Readiness within six years a high-temperature turbine for use in a combined cycle using coal-derived fuel at a firing temperature of 2600°F with growth capability to 3000°F. The program is to be conducted in three phases: program and system definition (phase I); technology testing and test support studies; and technology readiness verification test program (Phase III). The

Phase I effort to provide program and system definition for the HTTT Program includes a task to establish two reference 2600°F turbine subsystem designs. A prime and three backup reference turbine subsystem designs were evaluated for application to systems using low-Btu gas at 2600°F with growth capability to 3000°F (a 16:1 compressor pressure ratio was assumed for turbine design calculations). In establishing these reference design configurations, tradeoffs were made considering factors such as fuels flexibility, performance, water consumption, cost, past experience, development risks, further growth potential, manufacturability, and materials and processes. The prime approach shown in Table 1.1-1 was used as a starting point with candidate backup designs shown in Table 1.1-2 also evaluated. The reference design of the turbine subsystem included a definition of the gas path, buckets, nozzles, casings and shrouds, turbine wheels, spacers, shafting, and diffusers. Measurements were made of material properties and processes in support of the turbine subsystem design work. The work performed and data obtained in these evaluations are reported.

54920 (FE—1806-50) **Development of high temperature turbine subsystem technology to a "technology readiness status": Phase II. Progress report for June 1978.** Caruvana, A. (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). 10 Jul 1978. Contract EX-76-C-01-1806. 59p. Dep. NTIS, PC A04/MF A01.

Specifications for the Hot Gas Path Development Test Stand (HGPDTS) Closed Loop Water Cooling System Control Valves have been released and included in a bid package. Piping diagrams have been revised to comply with updated flow diagrams. Final bids have been received on heat exchangers. A detailed manufacturing plan for the HGPDTS first stage nozzle is being prepared. TRW has initiated the manufacture of the core tooling needed for the second stage nozzles. A conceptual design of the "simulated" first stage nozzle is under way. This nozzle is used for combustor development tests only. Modifications to the existing test section of the Turbine Simulator are complete. Reassembly with the metal ceramic hybrid combustor is under way. Combustor testing will begin shortly. Design of the test specimen is continuing. Material selection for the composite specimen have been made. Velocity distribution determination of the flow thru a cascade continued. New heat gauges for use in the shock tunnel tests have been fabricated to replace the worn and solvent affected sensors. Detailed design of the Pilot Gas Clean Up System continues. DOE purchased approval on the pressure vessels has been received. Bid packages for plant construction are being prepared. The horizontal cooling passage test specimens are ready for test in the Motorized Rig. Fabrication of the test specimens for the Air Turbine tests is in progress. Updates to the liquid and gas fueled combined cycle power plant designs are reported. A change in the design of the water delivery path from the bore to the bolt circle to that of a cone with discrete water tubes is being analyzed. Justification for the two stage sectoral combustor is presented in a unique graphical form. Results of a vibrational analysis on the combustor and fuel pipe are discussed. Current status of the design, manufacture, materials, and process development for each stage of the turbine (nozzles and buckets) are presented.

54921 (FE—2556-12) **Development of a ceramic tube heat exchanger with relaxing joint. Quarterly technical progress report, October 1977—January 1, 1978.** Ward, M.E.; Napier, J.C. (Solar Turbines International, San Diego, CA (USA)). 15 Jan 1978. Contract EF-77-C-01-2556. 60p. Dep. NTIS, PC A04/MF A01.

High temperature radial compression tests on sintered silicon carbide (NC-430, Norton), and Super KT silicon carbide (Carborundum) were completed. High temperature radial compression tests on alpha sintered silicon carbide (Carborundum) were started. Results of glass joint relaxation/deflection tests completed before and after the joint undergoing a 500 h thermal stability test showed a negligible increase in permeability. A glass extrusion test of a glass joint which initially contained a small leak (1×10^{-6} lb/sec) was shut down after 10 h due to a significant increase in leakage. It is recommended that the counter-axial flow heat exchanger be the design advanced by this program. Gas tight permanent joints were made using tube-sleeve silicon joint. A ceramic heat exchanger ceramic-to-metal joint is detailed.

54922 Coal-burning gas turbine combustion system for reducing turbine erosion. Giles, W.B. (to General Electric Co.). US Patent 4,089,631. 16 May 1978. Filed date 23 Sep 1976. 8p.

Gas-fluidized ground coal, and coal dust slurried with fuel oil, are supplied to a reverse flow cyclone combustor which provides the functions of combustion and particulate removal. Coal dust borne by the fluidizing gas is passed through a cyclone scrubber utilizing fuel oil, and the resulting slurry is introduced into the combustor adjacent the inner surface of the combustor wall. Only the finest coal dust is employed in the slurry, to minimize oil consumption. Separative performance of the combustor is enhanced by introducing combustion air centrally adjacent the combustor outlet and gas-borne ground coal directly onto the cyclone walls.

54923 Contribution to the long-term survey of a steam turbine. Sindelar, R. *Brennst.-Waerme-Kraft;* **30**: No. 5, 207-214(May 1978). (In German).

The limit control of thermal stress in turbine components is of special importance, especially in respect of the survey of the long-term life time. Therefore, it is recommended that a high priority be given to this control. A definite solution is offered which guarantees that the admissable stresses in components are not exceeded during the changing operation, even in hand-controlled turbines. The design and the experiences with a thermophysical and an electrical simulator for the determination of the temperature strain of the rotor are discussed. The experience during several years of operational usage show that the electrical simulator is preferable to the thermophysical one.

54924 Gas turbines for combined district heating and power stations. Schwarzenbach, A.; Frutschi, H.U. *Brennst.-Waerme-Kraft;* **30**: No. 5, 203-206(May 1978). (In German).

The aim for increased utilisation of fossil fuels requires the combination of district heating and power stations. The application of gas turbines to dual-purpose power plants is discussed. After having already published the use of a gas turbine for the modernisation of an existing district heating station at the city of Bochum, the present contribution presents solutions for the grid construction in stages low investment costs. The use of gas turbines with waste-heat and peakload boilers is particularly suited for this purpose.

54925 New approximation formula for the thermodynamic quantities of steam dependent on enthalpy and entropy. Schwindt, H. *Brennst.-Waerme-Kraft;* **30**: No. 1, 30-32(1978). (In German).

For calculating steam turbines and cycle processes in thermal power stations, it may be desirable to have available in a computer the pressure and the temperature of steam in relation to the enthalpy and entropy, in a compact form. Following the first formulation published in BWK (1970) no. 12, p. 578/88, binary polynomes are stated which give the values in compact form for the range of superheated steam without additional correction terms. Furthermore, the accuracy has been increased, compared with the first formulation.

54926 Double- and four-pole power plant generators from the engine works of AEG-TELEFUNKEN. Paul, G.; Schlutius, H.F. *Tech. Mitt. AEG-Telefunken;* **68**: No. 1/2, 66-74(1978). (In German).

A survey of the manufacture of AEG-TELEFUNKEN's two- and four-pole power plant generators is presented. The electric design, constructional specifications, operational behaviour, exciter systems, and the testing of these machines are discussed. The text is illustrated by graphical representations and photos.

54927 Application of gas turbines for peak load and base load operation. Gard, M. *Tech. Mitt. AEG-Telefunken;* **68**: No. 1/2, 41-47(1978). (In German).

Some characteristic data on the gas turbines of AEG-KANIS are presented. Figures on efficiency and specific prices enable profitability considerations for various kinds of operation, taking into account the fuel available and the fuel prices at the time. The impact of gas turbine operation on the environment is briefly discussed.

54928 Design criteria and calculation of modern steam turbines. Koerner, K. *Tech. Mitt. AEG-Telefunken;* **68**: No. 1/2, 18-24(1978). (In German).

The basis on which AFG-KANIS designs its steam turbines for power generation and for driving compressors is discussed. Construction of a turbine requires, because of the multitude of parameters, close cooperation with the department responsible for technical calculations, since many studies on the strength of materials, thermodynamics, and vibration have to be carried out. However, operational safety and low steam consumption are main points in all cases of application.

54929 Device for steam quantity and pressure control. Krueger, K.H.; Altfelder, R. (to Uhde (F.) G.m.b.H.). German(FRG) Patent 2,412,804/B/. 27 Jan 1977. 3p. (In German).

The device in the form of a combined control and regulation circuit ensures a constant supply of steam at medium pressure in a large plant equipped with high pressure and medium pressure steam system. The device operates when the medium pressure steam, which is normally supplied by one or several high pressure turbines as waste steam, fails, for example due to turbine shutdown. The required switchover of the steam paths then occurs by fast opening and control valve, without causing pulsation, i.e., pressure and quantity variations. This specially equipped valve can be controlled in 2 ways: (1.) by 'closed drive' in the 'closed' position, as long as the fast shutdown control of the turbine does not operate, i.e., in normal operation, and (2.) by normal drive to any position. Any position can only be prepared by suitable spring tension, as long as the closed drive keeps the valve closed. The pretensioning of the spring is proportional to the quantity of steam measured, which is accepted

by the turbine and taken to the medium pressure system. If the fast shutdown control system operates, then the closed drive releases the valve and this goes immediately (without normal setting time) to the position prepared by the pretensioned spring. In this position the valve supplies the same quantity of steam to the medium pressure steam as the turbine did before. By the operation of the fast shutdown control system, the further valve control is switched over from steam quantity measurement (steam quantity is now zero) to a normal pressure control with comparison of actual value/reference value. The valve can also supply an additional quantity of steam to the medium pressure system during start-up of the turbine(s).

54930 Fluidized bed steam generators. Dixit, D.K. (Visvesvaraya Regional Coll. of Engineering, Nagpur, India); Chandak, S.R. *Indian East. Eng.;* No. 119, 71-74(1977).

The development, operation, performance, pollution control aspects, and economics of fluidized bed steam generators for power plants are discussed, and the advantages for using fluidized combustors in India which has large quantities of poor grade coal are described. (LCL)

54931 Edge protection for turbine blades. van Rensen, E.; Schmidberger, R. (to Dornier-System G.m.b.H., Friedrichshafen (Germany, F.R.)). German(FRG) Patent 2,535,251/B/. 16 Sep 1976. 3p. (In German).

The task of increasing the life of turbine blades wetted with droplets is solved by special technology in the manufacture of these blades or of their edges. The edge protection of cast hard metal receives a fine dendrite structure during hardening, with dendrites at right angles to the direction of droplet impact. The particular degree of fineness of the dendrite structure (dendrite diameter less than 0.01 mm) and the homogeneousness of dendrite orientation are important. A stellite edge as edge protection can be hardened in its final form or can be worked from a hardened block, so that the dendrite orientation runs at right angles to the direction of droplets. The effect of the measures according to the invention is shown in micrographs of 'old' and 'new' edges. The percentage contents of 8 elements including mainly Cr with 25 to 30% are given for the composition of a melt of a stellite edge.

54932 Steam raising unit with vertical pressure vessel. Von Hollen, R.F. (to to Combustion Engineering, Inc.). German(FRG) Patent 2,523,874/B/. 22 Jul 1976. 5p. (In German).

A solution is given for the problem of removing deposits in a steam raising unit with heating tubes, according to which the regularly required cleaning can be carried out in a simple and economical way. A washing room is provided for this inside the steam raising unit and a cleaning collector is provided externally. The vertical cylindrically shaped boiler widening at the top is heated by U-tubes standing on a tube plate. A suitable heating medium is taken via a space under the tube plate and via a neighbouring space from the first separate space. 25 to 50 mm above the tube plate a guiding sheet fills up the whole circular crossection of the boiler. Apart from the holes for the heating tubes it has further holes, and with the parallel tube plate it forms a flat cylindrical washing room. This room is divided by radial intermediate walls (12 in number, for example) into 12 sectors. Each sector is connected via a radial tube, and a valve with an annular body outside, concentric to the boiler axis, i.e. the cleaning collector. By opening and closing each valve, each sector room in turn can be cleaned. For a given total flow, each sector obtains a maximum cleaning flow through the appropriate holes in the guiding sheet. An optimum amount of cleaning and a saving of cleaning fluid is achieved.

54933 Gas turbine guide vane. Franklin, C.J. (to Brown Boveri-Sulzer Turbomaschinen A.G.). German(FRG) Patent 2,453,801/C/. 6 May 1976. 6p. (In German).

The cooling, particularly at the blade outlet edge, is improved by special guidance of the cooling air inside the guide vane. The cooling air is taken via the foot of the blade to an insert, which is kept at the right distance inside the outer cover of the blade by channels forming ribs. The hollow space between the outer cover and the insert is divided in the area of the blade inlet edge by a sealing bar in the longitudinal direction of the blade. The cooling air first flows through holes along the sealing bar in the pressure side of the blade into an impact space behind the inlet edge, and cools this. Along the inner pressure side of the blade, the cooling air flows through the above-mentioned channels to the blade outlet edge and partly leaves the blade there through holes. The other half of the cooling air flows inside the hollow space through further channels along the suction side of the blade back to the blade inlet edge, leaves the blade there through holes and flows as a film of coolant along the outside of the blade. The improved cooling effect is achieved by the cooling of the outlet edge taking place with cooler air than if this took place at the end of a cooling section with already heated air.

54934 Axial gas turbine plant. Lee, R. (to Westinghouse Electric Corp.). German(FRG) Patent 2,507,182/A/. 4 Sep 1975. 19p. (In German).

The specially designed stator cooling of a gas turbine ensures that parts of the rotor and stator which do come into contact with the hot driving gas in operation are not affected by this gas and unnecessarily stressed. While guide vanes and rotor blades, for example, and particularly their edges require very high quality materials, many other parts can be manufactured of less expensive materials under the conditions created by the invention. Cooling air is taken via individual pipes to each stator stage (to the circular chamber surrounding each ring of blades). The pressure is suited to the varied requirements by extraction from a suitable stage of the turbine compressor. The pressure of this cooling air is always higher at all the points where it meets the hot medium than the latter's pressure, in order to ensure the required effect above. From the outer circular space the cooling air flows through channels in the guiding vanes (cooling these) into a circular space within the blade ring. From there the air is further distributed via several channels or groups of channels to all the spaces between the stator stage and a rotor stage in front of it, and the subsequent rotor stage. It leaves these spaces through wearing seals between rotating and stationary parts and also cools the foot region of the following rotor stage. The transition of the cooling air from the stator body to the rotating foot region takes place with only small turbulence due to suitably transverse air channels.

54935 Moving blades for turbines. Bischoff, H. (to Motoren- und Turbinen-Union G.m.b.H.). German(FRG) Patent 2,405,050/A/. 7 Aug 1975. 11p. (In German).

With moving blades, according to the invention, it should be possible to achieve both small gap losses in blades with shroud bands and as high a speed of rotation as possible in a turbine. This makes it possible to fit a shroud plate at the tip of the blade, which is positioned tangentially to the circumference circle of the blade and is slightly domed. This relatively small plate with its small dimension permits higher speeds of rotation than a shroud band closed in a circle. The plate lengthens the flow path between suction and pressure side, which reduces the leakage flow. The leakage flow can be further reduced by a small projection of the shroud plate in or opposite to the direction of rotation, and hooking of the plate or too great a bending moment on the blade can be prevented. For air cooled blades, the leakage flow is limited, i.e., further reduced, by the cooling air leaving the blade tip. As minimum gap losses are achieved with a smaller shroud plate, such blades can run at very high speeds. By thinning the front of the shroud plates, shock and turbulence losses on the suction side are prevented and the release of the leakage flow and its limitation are achieved.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 55346

54936 Thermal storage with molten salt for peaking power. Nelson, H.E. (to Stone and Webster Engineering Corp.). US Patent 4,094,148. 13 Jun 1978. Filed date 14 Mar 1977. 16p.

An improvement in the process for the generation of electrical power is described in which heat released by exhaust gases derived from the combustion of gaseous products in a coal gasification process is stored and utilized to generated increased electrical power during peak demand periods.

ECONOMICS

REFER ALSO TO CITATION(S) 55258, 55259

54937 (PB—276082) **The long-run incremental cost of electric utilities. Final draft report.** (Ernst and Ernst, Washington, DC (USA)). Oct 1977. 214p. NTIS PC A10/MF A01.

This project evaluated three methods for determining the marginal cost of electricity generation, transmission, and distribution. A description of the model developed during this project and the test results as well as the methods used by two other researchers are included. A production function is estimated and a long-run total cost equation is derived by minimizing cost subject to the production function and required outputs. The total cost function is then differentiated to arrive at the marginal costs.

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 54927

FUELS

54938 (FE—1806-24) **Overall Plant Design Description (OPDD) coal derived liquid electric power plant.** (General Electric Co., Schen-

ectady, NY (USA). Gas Turbine Div.). Jul 1977. Contract EX-76-C-01-1806. 80p. Dep. NTIS, PC A05/MF A01.

The Case C power plant fueled with coal-derived liquid (CDL) fuel generates 443,500 kW of electrical power with an overall thermal efficiency of 48.66 percent based on higher heating value coal liquid to busbar. (The CDL manufacturing cycle is 67 percent efficient and when taken into account reduces the overall plant efficiency to 32.60 percent.) The power plant consists of six major systems organized for presentation as follows: the fuel system, the prime cycle system, the bottoming cycle system, the balance-of-plant system, the integrated plant control system, and the electrical power system. Each is described. The fuel system includes coal-derived liquid fuel storage and equipment to store, heat, clean and pump CDL. The prime cycle system includes: the high-temperature gas turbine prime movers, the hydrogen-cooled electrical generators, the axial turbine exhaust system which supplies heat to the steam generator, and associated off-base subsystems which support the gas turbine generators. The bottoming cycle includes: the heat recovery steam generator, the steam turbine prime mover, the electrical generator and the major auxiliary support subsystems, such as the condenser and boiler feed pumps. The balance-of-plant system includes: water supply and preparation equipment, heat rejection equipment including cooling towers and stacks, other mechanical and electrical support systems, and remaining plant services. The integrated plant control includes: a central control room which houses control of all plant functions, including coal-derived liquid supply, prime cycle and bottoming cycle operation to meet electrical load demand and operate within environmental standards. The electrical power system includes equipment provided for internal plant electrical power supply to the major plant systems and equipment required to connect gas and steam turbine generators to the output electrical power high line.

54939 Fluidised bed combustion: a new route to power and heat from coal. Schilling, H.D. (Bergbau-Forschung G.m.b.H., Essen (Germany, F.R.)). *Glueckauf;* **114**: No. 3, 142-147(Feb 1978). (In German).

The functioning of fluidized-bed firings and their advantages with regard to SO_2 emissions are described. The principle of design of a fluidized-bed boiler and a gas/steam turbine power plant with fluidized-bed firing under pressure is outlined. The application and their economics in heat and power generation and marketing potential of fluidized-bed firings and their economics in heat and power generation is pointed out. The construction of waste-fired incinerators has already become possible, but there is still a lot of development work to be done until fluidized-bed firings can be used in central heatings, combined-cycle power plants, and large power plants.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 54352

54940 (DOE/EA—0033) **Coal conversion program environmental assessment: Virginia Electric Power Company, Portsmouth Generating Station, Power Plants 1, 2, 3, and 4, Portsmouth, Virginia.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). Mar 1978. 119p. Dep. NTIS, PC A06/MF A01.

A report is given of an environmental assessment of the proposed Notice of Effectiveness to make effective the prohibition order prohibiting burning of gas or oil as the primary energy source at the Virginia Electric Power Company's Portsmouth Generating Station, powerplants 1, 2, 3, and 4. Based on the 1975 fuel split and the projected use of the powerplants following conversion, conversion to coal at Portsmouth will save the equivalent of approximately 3.8 million barrels of oil per year. Findings made in the process of issuing prohibition orders to the Portsmouth station indicate that conversion of powerplants 1, 2, 3, and 4 to coal should decrease the consumer cost of electricity from the Virginia Electric Power Company between $.00013 and $.00089 per kWh. Potential environmental impacts of converting this facility to coal are given. These include air pollution, land use, water pollution, and ecosystems.

54941 (PB—277086) **Precipitation chemistry of magnesium sulfite hydrates in magnesium oxide scrubbing. Final task report Jul 75—Dec 76.** Lowell, P.S.; Meserole, F.B.; Parsons, T.B. (Radian Corp., Austin, TX (USA)). Sep 1977. Contract EPA-68-02-1319. 377p. NTIS PC A17/MF A01.

The report gives results of laboratory studies defining the precipitation chemistry of $MgSO_3$ hydrates. The results apply to the design of Mg-based scrubbing processes for SO_2 removal from combustion flue gas. In Mg-based scrubbing processes, $MgSO_3$ precipitates as either trihydrate or hexahydrate. The hydrate formed depends on equipment design and operating conditions. Theoretical prediction, verified experimentally, indicated that $MgSO_3$ trihydrate is the theromodynamically stable hydrate formed at scrubbing process conditions. $MgSO_3$ hexahydrate is formed as a metastable solid due to kinetic phenomena. Nucleation and crystal growth rates are much faster for hexahydrate than for trihydrate. The time scales observed in kinetic experiments at scrubbing process conditions are: hexahydrate precipitation (10's of minutes), hexahydrate dissolution and trihydrate precipitation (100's of minutes), and attainment of trihydrate equilibrium (1000's of minutes). Nucleation plays a dominant role in the formation of trihydrate solids. These results indicate that Mg-based scrubbing process can be designed to precipitate a majority of either hydrate form. Important design variables include scrubbing liquor composition and temperature, seed crystal composition, slurry volume, equipment residence times, and energy inputs to the slurry that influence nucleation.

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 55917

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 54350, 54355, 54930, 55287, 55845

54942 (ANL/EES-CP—6) **Effects of the proposed new source performance standards: a comparative assessment of the energy and economic impact.** Farber, P.S.; Livengood, E.D. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 22p. (CONF-780636—6). Dep. NTIS, PC A02/MF A01.

From 71. Air Pollution Control Association meeting; Houston, TX, USA (25 Jun 1978).

Implementation of the proposed NSPS, for coal-fired power plants, will result in increased costs of power generation. In order to study the effect of the proposed vis-a-vis existing NSPS, a number of coal sources were chosen to adequately represent the various coal supply regions in the U.S. Power plant scenarios were chosen to reflect both the "mine mouth" type of power plant and the effects of interstate coal shipment. Case studies were performed in order to determine the least-cost mix of coal type and control techniques (particulate, FGD, coal cleaning, and NO/sub x/) needed to meet present and proposed NSPS. Costs and energy usage for environmental control were derived on an incremental basis with respect to a 500 MWe output base power plant. It was found that, with careful selection of coal type, coal cleaning may still give an economic and energy tradeoff to pollution control. In addition, capital investment for particulates and FGD will increase about $30/KW for high sulfur coals and $70/KW for low sulfur coals. Operating costs will increase approximately 2 to 3 mills/Kwhr using flue gas bypass to reduce reheat requirements; without bypass both capital and operating cost increments approximately double.

54943 (EPRI-FP—775) **Economic evaluation of fabric filtration versus electrostatic precipitation for ultrahigh particulate collection efficiency. Final report.** Campbell, K.S.; Scheck, R.W.; Severson, S.D.; Horney, F.A.; Ensor, D.S.; Markowski, G.R. (Stearns-Roger, Inc., Denver, CO (USA); Meteorology Research, Inc., Altadena, CA (USA)). Jun 1978. 137p. Dep. NTIS, PC A07/MF A01.

The relative economics of electrostatic precipitators and fabric filters were studied for a variety of U.S. coals. The economic selection in each case was found to be dependent on the particulate emission limit to be met, the physical and chemical characteristics of the coal and fly ash, and the bag replacement schedule of the fabric filter. The studies were based on a 500 MW (net) pulverized-coal-fired power plant provided with a well-designed fly ash collector system of high reliability. For systems designed to meet the federal particulate emission limitation of 0.1 lb/10^6 BTU, the electrostatic precipitator had a clear advantage in one of the four cases. For systems designed to meet the more stringent New Mexico regulation of 0.05 lb/10^6 BTU, the fabric filter had a significant economic advantage in three of the four cases. If designs are based on obtaining a clear stack plume, the fabric filter has a significant advantage. The results clearly indicate that precipitator costs increase significantly as collection efficiency requirements are increased. Baghouse costs, on the other hand, remain essentially constant due to their inherently high collection efficiency. Baghouses become the economic choice for all coals, even low-resistivity eastern ones, when permissible emission levels drop much below the current NSPS of 0.1 lb/10^6 BTU. This conclusion must, of course, be tempered by the fact that no large, modern, pulverized coal units are presently operated with a baghouse, and therefore no accurate reliability record is available. This is especially critical to high sulfur coals where problems of corrosion have a greater probability of occurring than with low sulfur coal.

54944 (EPRI-FP—792(Vol.2)) **Study of electrostatic precipitators installed on oil-fired boilers. Final report.** Dean, A.H. (Southern

Research Inst., Birmingham, AL (USA)). Jun 1978. 185p. Dep. NTIS, PC A09/MF A01.

The use of electrostatic precipitators for collection of effluent from oil-fired boilers in the utility industry is discussed. Basically, the information is presented in two sections--literature survey and industry survey. The objectives were to document usage of electrostatic precipitators on oil-fired utility boilers, to present any available design and performance data, to discuss the operating experience, and to present procedures employed to remedy problems identified during the study. Included is a detailed report concerning costs of an electrostatic precipitator for a hypothetical 100 MW oil-fired utility plant; costs were based on year 1971 and are updated to 1976. The report endeavors to serve the reader as a working reference. Where additional details are desired these can be obtained via a careful listing of reference material and easy identification of references in the text of the report.

54945 (EPRI-FP—792(Vol.2)) **Study of electrostatic precipitators installed on oil-fired boilers. Volume 2. Final report.** Dean, A.H. (Southern Research Inst., Birmingham, AL (USA)). Jun 1978. 184p. Dep. NTIS, PC A09/MF A01.

The use of electrostatic precipitators for collection of effluent from oil-fired boilers in the utility industry is discussed. A literature survey and industry survey are presented. The objectives were to document usage of electrostatic precipitators on oil-fired utility boilers, to present any available design and performance data, to discuss the operating experience, and to present procedures employed to remedy problems identified during the study. Included in the report is a U.S. Atomic Energy Commission's detailed report concerning costs of an electrostatic precipitator for a hypothetical 100 MW oil-fired utility plant; costs were based on year 1971 and are updated to 1976. The report endeavors to serve the reader as a working reference. Where additional details are desired these can be obtained via a careful listing of reference material and easy identification of references in the text of the report.

54946 (LA—7286-MS) **Preliminary design of a prototype particulate stack sampler.** Elder, J.C.; Littlefield, L.G.; Tillery, M.I.; Ettinger, H.J. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 19p. Dep. NTIS, PC A02/MF A01.

A preliminary design of a prototype particulate stack sampler (PPSS) has been prepared, and development of several components is under way. The objective of this Environmental Protection Agency (EPA)-sponsored program is to develop and demonstrate a prototype sampler with capabilities similar to EPA Method 5 apparatus but without some of the more troublesome aspects. Features of the new design include higher sampling flow; display (on demand) of all variables and periodic calculation of percent isokinetic, sample volume, and stack velocity; automatic control of probe and filter heaters; stainless steel surfaces in contact with the sample stream; single-point particle size separation in the probe nozzle; null-probe capability in the nozzle; and lower weight in the components of the sampling train. Design considerations will limit use of the PPSS to stack gas temperatures under approximately 300°C, which will exclude sampling some high-temperature stacks such as incinerators. Although need for filter weighing has not been eliminated in the new design, introduction of a variable-slit virtual impactor nozzle may eliminate the need for mass analysis of particles washed from the probe. Component development has shown some promise for continuous humidity measurement by an in-line wet-bulb, dry-bulb psychrometer.

54947 (NTIS/PS—78/0176) **Detection and sampling in flue gases (a bibliography with abstracts). Report for 1964-Mar 78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 267p. NTIS PC N01/MF N01.

Reports are cited which discuss the detection and sampling of combustion product flue gases within the stack and at the stack exit. Detector design is covered, along with detection techniques for all types of possible pollutants, including NOx, SO_2, CO, and particulates. (This updated bibliography contains 262 abstracts, 76 of which are new entries to the previous edition.)

54948 (PB—276339-T/SL) **Air conservation. Volume 10, number 5(55), 1976.** Translated by A. Skup from *Ochr. Powietrza;* **10**: No. 5, vp.(1976). 79p. (TT—76-54024/5). NTIS PC A05/MF A01.

The following topics are discussed: current development in the design of centrifugal mist eliminators; solid and gaseous emissions from the oil-fired thermal power plants; radioisotopic measurement of surface density of the dust mat deposited on the bag filter cloth; wet cyclone of ZOA-2 type; Dust pelletizing technique for power industry generated dust and the environment pollution control; effect of the municipal waste disposal technology on air pollution and effects of the sulfur content of the charge in the iron ore sintering plants on SO_2 emission into the atmosphere.

54949 **Catching a sulphur cloud over the North Sea.** *Electr. Rev. (London);* **202**: No. 24, 16-17(23 Jun 1978).

The accusation that fish stocks and the ecology generally in Scandinavia have been affected by acid rain originating from power stations in UK has been taken seriously by scientists from Britain's Central Electricity Research Laboratories as well as by Norwegians. It is found, however, that the physics and chemistry involved are not as straightforward as they might seem. Efforts being made to discover the mechanisms involved are discussed.

54950 **Method of reducing nitrogen oxide emissions in flue gas.** Jones, D.A.; Mansour, M.N. (to Southern California Edison Co.). US Patent 4,095,928. 20 Jun 1978. Filed date 14 Feb 1977. 10p.

A process for the simultaneous combustion of nitrogen-rich fuels and nitrogen-poor fuels which results in the production of less nitrogen oxide emissions is described.

54951 **Air pollution control device.** Roy, J.R.; Roy, S.; Roy, M.L.; Mooney, D.T. (to Airtek Corp.). US Patent 4,095,514. 20 Jun 1978. Filed date 8 Nov 1976. 8p.

An air pollution control device is described for controlling the velocity of discharge from an industrial chimney or smokestack in order to optimize the plume rise and thereby minimize air pollution comprising a variable pitch truncated cone adapted to be mounted at or near the top of the chimney or stack, said cone being constructed to be expandable and contractible with respect to the axis of the chimney or associated flue or flues and kinematic means manually or automatically operable to control the size of the flow path of the gases through the truncated cone.

54952 **Regeneration of sulfated metal oxides and carbonates.** Hubble, B.R.; Siegel, S.; Cunningham, P.T. (to Dept. of Energy). US Patent 4,081,522. 28 Mar 1978. Filed date 7 Oct 1976. 8p.

PAT-APPL-730,751.

Alkali metal or alkaline earth metal carbonates such as calcium carbonate and magnesium carbonate found in dolomite or limestone are employed for removal of sulfur dioxide from combustion exhaust gases. The sulfated carbonates are regenerated to oxides through use of a solid-solid reaction, particularly calcium sulfide with calcium sulfate to form calcium oxide and sulfur dioxide gas. The regeneration is performed by contacting the sulfated material with a reductant gas such as hydrogen within an inert diluent to produce calcium sulfide in mixture with the sulfate under process conditions selected to permit the sulfide-sulfate, solid-state reaction to occur.

54953 **Industrial processes for desulfurization of power station flue gases.** Dubois, J. (Electricite de France, Paris). *Rev. Gen. Therm.;* **17**: No. 195, 193-198(Mar 1978). (In French).

The need to clean power station flue gases has led to studies of several processes which transform sulfur dioxide in flue gases into sulfite or sulfate residues to be thrown away (reject processes), or into sulfur or SH_2, which can be recovered (recovery processes). The present worldwide situation and the process used by each manufacturer and the product obtained in existing industrial installations are described.

54954 **Processes for desulfurization of flue gases experimentally studied by Electricite de France.** Blanc, H. (Electricite de France, Paris). *Rev. Gen. Therm.;* **17**: No. 195, 199-206(Mar 1978). (In French).

The various sulfur removal processes studied experimentally by Electricite de France are listed, and the program of tests carried out are described. The processes include: the Weiritam Kuhlmann process (washing with ammonia solution followed by treatment with milk of line); Ugine Kuhlmann process (sulfur removal by ammonium sulfite followed by production of SO_2 by inversed reaction); and Serecsen process for ozone sulfur removal. These tests were not conclusive. The IFP treatment of sulfitic solutions obtained by washing combustion gases with ammonia solution leads to production of liquid sulfur. The good test results obtained allow industrial scale use of this process to be envisaged.

54955 **S.T. (C.I.T.-Alcated) process for desulfurization of flue gases.** Salauen, A.; Trempu, R. *Rev. Gen. Therm.;* **17**: No. 195, 207-209(Mar 1978). (In French).

The principle of the S.T. process for removing sulfur from flue gases is described. This process involves catalytic oxidation of sulfurous anhydrides gives a dilute sulfuric acid solution and concentration of the solution by heat recovery from the flue gases. The results of an economic analysis appear promising.

SITE SELECTION AND LAND USE

REFER ALSO TO CITATION(S) 55254, 55318

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 54491, 54964, 55319

54956 (NTIS/PS—78/0187) **Lighting, surge, and transient protection (a bibliography with abstracts). Report for 1964-Feb 78.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 267p. NTIS PC N01/MF N01.

Techniques and devices for the protection of electronic and electrical equipment are presented in these Federally-sponsored research reports. The citations include research on suppressors, limiters, lightning arresters, electromagnetic pulse protection devices, and overvoltage protection networks. (This updated bibliography contains 262 abstracts, 64 of which are new entries to the previous edition.)

54957 **Method and apparatus for protecting electrical systems from lightning strike effects.** Plumer, J.A. Jr. (to General Electric Co.). US Patent 4,093,978. 6 Jun 1978. Filed date 24 Dec 1975. 8p.

Electrical apparatus and power distribution systems are protected from lightning strike currents and voltages by the addition of mutually coupled chokes, such as bifilarly wound chokes, in electrical series relationship with the apparatus and the power distribution system to increase the impedance therebetween and cause lightning currents to flow along alternate current paths.

54958 **Computer investigation of the laws governing the susceptance to failure of installations.** Farchadzadeh, E.M. (Azerbajdzhanskij Inst. Nefti i Khimii, Baku (USSR)). *Arch. Energiewirtsch.;* **32**: No. 2, 142-145(Feb 1978). (In German).

In the practice of safety investigations of installations in networks, it is assumed that the general laws pertain to the given situation. The question whether this assumption of the validity of the general laws is correct has been objectively investigated by statistical modelling. The algorithm for this has been established. The usefulness of developing methods to determine alterations increasing the safety of installations is pointed out. The assumption that the general laws are valid in a given situation may result in distortions which render the findings of an investigation practically useless.

54959 **Planning rules for high-voltage power systems.** Gaertner, R. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Hochspannungstechnik und Starkstromanlagen). *Arch. Elektrotech. (Berlin);* **60**: No. 1, 9-16(1978). (In German).

An important question in the planning of high-voltage power systems is the determination of the highest voltage level. A study of an idealised power transmission system should be able to give informative answers to questions mentioned above. No further details of the planned transmission system need be known except the average power density and the average distance of transmission. One decisive parameter in this regard is the maximum allowable short-circuit current.

AC SYSTEMS, EHV AND UHV

REFER ALSO TO CITATION(S) 55318

54960 (EPRI-EL—802) **Electrostatic and electromagnetic effects of ultrahigh-voltage transmission lines. Final report.** Zaffanella, L.E.; Deno, D.W. (General Electric Co., Pittsfield, MA (USA)). Jun 1978. 368p. Dep. NTIS, PC A16/MF A01.

Results of research on electric and magnetic field effects of high voltage ac power lines, performed at EPRI's Project UHV from January 1974 to December 1977 are reported. Only "electrical" rather than "biological" research was performed. This research is applicable to UHV as well as to EHV transmission lines. Calculation method and measuring techniques have been developed for transmission line fields and their effects. Steady state and spark discharge currents induced in persons and objects have been investigated with laboratory and full scale tests using a three-phase UHV line. Different methods to reduce the electric field of UHV lines have been investigated, such as grids of grounded wires and lower voltage circuits built underneath the UHV lines. Unusual effects of high electric fields, such as people's reaction to various types of exposures, wood pole burning, and corona on grounded objects, were experienced during the operation of the UHV three-phase test line. These effects have been investigated and design data have been provided.

54961 **Transmission line reference book: 115—138 kV compact line design.** Barthold, L.O.; Clayton, R.E.; Grant, I.S.; Longo, V.J.; Stewart, J.R.; Wilson, D.D. Palo Alto, CA; Electric Power Research Institute, Inc. (1978). 192p. (NP—23255). Electric Power Research Inst., 3412 Hillview Ave., Palo Alto, CA.

Efficient use of transmission rights-of-way with minimal environmental impact has become one of the primary objectives of transmission system planners in virtually all industrialized countries. The EPRI project on compaction of high-voltage transmission lines, including an experimental line at Saratoga, New York, directly addressed this objective. The Saratoga compact line project emphasized 115- and 138-kV-class lines. The compaction techniques developed and documented in the project illustrate the viability of reducing phase-to-phase spacings in this voltage range from the conventional 10- to 14-foot range to as little as 3 feet. However, most of the concepts and procedures developed are applicable at lower system voltages, and many are applicable at least through 230 kV. The compaction project is reported in this design manual for 115- to 138-kV compact lines, drawing on experimental results from the Saratoga compact line project, on supplementary calculations made as a part of this project, and on a summary of previously published information germane to compact line design. It is directed to line design engineers who have a general understanding of line design methods. The Appendix gives the detailed results of the experimental work undertaken at Saratoga and is intended to serve as a further technical reference to users of the manual. The Appendix provides permanent documentation of the experimental work on the Saratoga compact line project to aid researchers who may wish to expand on this effort.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

54962 (BNL—24512) **Superconducting power transmission. Progress at Brookhaven and the prospects for this technology.** Forsyth, E.B. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 7p. (CONF-780718—2). Dep. NTIS, PC A02/MF A01.

From 7. cryogenic engineering conference; South Kensington, London, UK (4 Jul 1978).

The state of development of the technology at Brookhaven is described. This includes the 100 m outdoor test facility and the results of systems studies carried out in cooperation with electric utility companies. The status at other institutions throughout the world is given. It appears the first tests on an actual utility system will be carried out in Austria. Test stations for larger cables are under construction in the U.S.S.R. and the U.S.A.

54963 **From cryo cables to cables with internal water cooling.** Fischer, W.; Birnbreier, H. *BBC-Nachr.;* **60**: No. 3, 124-129(1978). (In German).

If energy consumption continues to increase, conventional high-voltage cables will in the near future reach their basic transmission capacity. The articles compares two possible solutions: cryo cable, whose conductors are cooled with liquid nitrogen and cables with internal water cooling. It becomes apparent that water-cooled cables can transmit higher capacities at lower costs than cryo cables and conventional cables.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 55251

54964 (BNWL-B—426(Rev.)) **Electric power transmission for a Hanford Nuclear Energy Center (HNEC).** Richardson, R.L.; Dowis, W.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 72p. Dep. NTIS, PC A04/MF A01.

A study of nuclear energy centers was conducted by the Atomic Energy Commission and reported in WASH 1288, Evaluation of Nuclear Energy Centers, January 1974. The portion of the study covering a Hanford Nuclear Energy Center (HNEC) was conducted by Battelle-Northwest, and a preliminary study of transmission of HNEC power was prepared with the assistance of the Bonneville Power Administration (BPA). In 1975 the Energy Research and Development Administration (ERDA) requested a more detailed study of the HNEC, one aspect of which focuses on the transmission system. The transmission system was developed through a series of technical discussions with BPA personnel responsible for transmission system planning. The purpose of the discussions is to further develop a concept of a system which will transmit power from HNEC to markets in the Pacific Northwest, and to compare it with a system to serve the same loads from dispersed generating capacity; the major portion of the dispersed capacity would be in the general vicinity of load centers. The latter alternative would follow conventional siting practice and is referred to as a distributed (DIST) 100% system or case for 1998, and (DIST) 150% case for 2002. The planning of a power transmission system is an iterative process developed over a considerable time period. The report is an initial iteration, and substantial further studies will be required to firm up a transmission system from an HNEC, should such a generation expansion develop. Some of the required additional studies are presented in the last section of the report.

54965 (DOE-tr—107) **Availability of nuclear power plants of the world in 1976.** Moraw, G.; Szeless, A. Translated from *Atomwirtsch., Atomtech.;* **22**: 227-230(1977). 9p. Dep. NTIS, PC A02/MF A01.

The survey of the availability of the nuclear power plants of the world includes (without COMECON Countries) 127 plants with a total of over 70,000 MWe, which are classified according to reactor type and geographical distribution. Their average production utilization in 1976 was 64%, about 2% above 1975. Stade (Federal Republic of Germany) and Pickering-1 and -2 (Canada) stood at the top of the list with 94%. 33% of all plants reached more than 50%. The average time utilization of all the plants was 75%, about 1% above 1975.

54966 Heterogeneous gas core reactor. Han, K.I. Gainesville, FL; Univ. of Florida (1977). 250p. University Microfilms Order No. 78-10,954.

Thesis (Ph. D.).

Preliminary investigations of a heterogeneous gas core reactor (HGCR) concept suggest that this potential power reactor offers distinct advantages over other existing or conceptual reactor power plants. One of the most favorable features of the HGCR is the flexibility of the power producing system which allows it to be efficiently designed to conform to a desired optimum condition without major conceptual changes. The arrangement of bundles of moderator/coolant channels in a fissionable gas or mixture of gases makes a truly heterogeneous nuclear reactor core. It is this full heterogeneity for a gas-fueled reactor core which accounts for the novelty of the heterogeneous gas core reactor concept and leads to noted significant advantages over previous gas core systems with respect to neutron and fuel economy, power density, and heat transfer characteristics. The purpose of this work is to provide an insight into the design, operating characteristics, and safety of a heterogeneous gas core reactor system. The studies consist mainly of neutronic, energetic and kinetic analyses of the power producing and conversion systems as a preliminary assessment of the heterogeneous gas core reactor concept and basic design. The results of the conducted research indicate a high potential for the heterogeneous gas core reactor system as an electrical power generating unit (either large or small), with an overall efficiency as high as 40 to 45%. The HGCR system is found to be stable and safe, under the conditions imposed upon the analyses conducted in this work, due to the inherent safety of ann expanding gaseous fuel and the intrinsic feedback effects of the gas and water coolant.

54967 Building a comprehensive spare-parts program. Hefter, G.L. (Stone and Webster Engineering Corp., Boston); Black, J.M. *Proc. Am. Power Conf.;* **39**: 200-207(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

With the current emphasis on improving availability in the design and construction of new power plants, more and more attention is being directed to the establishment of an adequate spare parts inventory. "Adequate," in this case, means more than having enough spare parts. It also means that the inventory is not excessive and that supporting documentation is provided for those parts that require it.

54968 Increasing reliability of nuclear steam systems utilizing operating experience feedback. Deddens, J.C.; Fahland, F.R. (Babcock and Wilcox Co., Lynchburg, VA). *Proc. Am. Power Conf.;* **39**: 216-223(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Increasing the operational reliability of power plants is clearly a principal challenge in the nuclear power industry today. The challenge is made difficult by the large increase in the capacities of modern nuclear plants compared with those of the immediately preceding generation; by the present relative immaturity of the average nuclear plant; by rigorous technical standards; and by a constraining regulatory climate. All of these factors make it important to use operating experience feedback effectively for increased reliability, in operating plants as well as those still being designed.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 55109, 55125, 55129, 55130, 55131, 55132, 55143, 55144, 55145, 55146, 55147, 55149, 55155, 55169, 55172

54969 (NEDO—21282-A) **General Electric Densification Program status.** Potts, G.A. (General Electric Co., San Jose, CA (USA). Boiling Water Reactor Systems Dept.). Mar 1978. 39p. General Electric Co., San Jose, CA.

In early 1974, the General Electric Company initiated an extensive program to characterize the densification resistance of current production fuel. This document presents: (1) the results of the recent densification characterization program; (2) a description of proposed GE densification model changes to most appropriately consider the characterization results; and (3) an assessment of the effect of the recent characterization on GE BWR fuel densification analysis results reported in GE fuel license submittals.

54970 (NEDO—23786-1) **Fuel rod prepressurization. Amendment No. 1.** Elkins, R.B. (General Electric Co., San Jose, CA (USA). BWR Projects Dept.). May 1978. 29p. General Electric, San Jose, CA.

This report describes the technical benefits and safety significance associated with prepressurizing GE BWR fuel rods with helium to 3 atmospheres. This potential design change results in minor changes to calculated plant safety parameters based on the currently approved licensing models. Prepressurization is a simple product improvement which enhances fuel reliability.

54971 (NIRS-M—20) **Problems in assessment of environmental radiation exposure due to light-water power reactor.** (National Inst. of Radiological Sciences, Chiba (Japan)). Jun 1977. 76p. (CONF-761199—). Dep. NTIS (US Sales Only), PC A05/MF A01.

From 4. NIRS seminar; Chiba, Japan (18 Nov 1976).

Individual papers were abstracted separately for the data base.

54972 (NUREG/CR—0112) **Evaluation of fission product afterheat. Quarterly report, October 1—December 31, 1977.** Spinrad, B.I. (Oregon State Univ., Corvallis (USA). Dept. of Nuclear Engineering). May 1978. 88p. (OSU-NE—7803). NTIS $6.00.

Work completed under the subject contract during the last quarter of 1977, together with a progress report on work still in progress at the end of that period, is reported. The goal has been to improve the understanding of shutdown power in reactors, particularly light water reactors primarily fueled with ^{235}U. Specifically, the aim has been to increase the precision and accuracy of our knowledge of decay power from fission products in the period 0—10^4 seconds after shutdown. This period of time is the most important for setting requirements on emergency core cooling systems (ECCS) under accident conditions.

54973 (DOE-tr—111) **Statistical study of the causes of shutdown periods in nuclear power plants with light water reactors.** Pinter, M.; Kaufman, J. Aug 1978. Translation of Austrian report. 6p. Dep. NTIS, PC A02/MF A01.

The data from a total of 25 pressurized water reactors and 19 boiling water reactors in the years 1971 to 1974 were used for these studies. In most cases, the data were taken from the IAEA reports: "Operating Experience with Nuclear Power Stations in Member States." The major point of the evaluation does not consist of recording the number of nuclear power plant stoppages for specific reasons, but rather in an analysis of the lost time period.

54974 Nuclear fuel element spacer means. Amaral, L.; Brayman, K.W.; Smith, B.A.. (to General Electric Co.). US Patent 4,089,742. 16 May 1978. Filed date 1 Nov 1976. 4p.

A spacer retaining element, which may be a fuel rod or water-containing rod, is provided with axially-spaced lugs, each adapted to be received in a slot in a fuel element spacer of a nuclear fuel assembly. When assembled, the lugs maintain proper axial spacing between the individual spacers and the lug-slot arrangement prevents the rod from rotating. Moreover, because the slot in the spacer can receive the lug from only one direction, the arrangement prevents the spacer from being inserted into the assembly upside down.

54975 Alteration of reactor installation (Unit 2) in the Hamaoka Nuclear Power Station of the Chubu Electric Power Co., Ltd. *Genshiryoku Iinkai Geppo;* **22**: No. 4, 5-6(Jun 1977). (In Japanese).

The report by the Committee on Examination of Reactor Safety to the Atomic Energy Commission of Japan concerning the alteration was presented; and its safety was confirmed. The contents of the alteration are as follows. The MCPR (minimum critical power ratio) values for the Unit 2 reactor are 1.23 in the period up to cycle 3 and during the period from the initial stage up to the core average burn-up of 1,000 MWd/t in each cycle thereafter; and 1.29 in the other period than those described above. The capacity of the spent fuel storage pool is changed to about 220% reactor core equivalent. Solid waste storage is used commonly to Units 1 and 2, with the capacity of about 2 years equivalent.

54976 Indoor switchyards for power stations. Mehta, D.B.; Menon, S.G. (Tata Consulting Engineers, Bombay (India)); Narasingarao, S.N. (Department of Atomic Energy, Bombay (India)). pp 128-131 of Symposium on operating experience of nuclear reactors and power plants. Bombay; Department of Atomic Energy (1977).

From Symposium on operating experience of nuclear reactors and power plants; Bombay, India (7 Feb 1977).

Special problems encountered in the design of the 230 kV switchyards of the coastal nuclear station at Tarapur, India, are

discussed. The remedial measures taken to overcome the deleterious effects of the salty sea water are also outlined.

54977 Special problems encountered in the design of 230 kV switchyards of coastal nuclear stations. Narasinga Rao, S.N.; Balasubramaniam, N. (Department of Atomic Energy, Bombay (India). Power Projects Engineering Div.). pp 124-127 of Symposium on operating experience of nuclear reactors and power plants. Bombay; Department of Atomic Energy (1977).

From Symposium on operating experience of nuclear reactors and power plants; Bombay, India (7 Feb 1977).

Off-shore power stations such as the one at Tarapur, India pose severe problems in respect of high voltage switchyards. The cause of insulation problems faced as well as the remedial measures taken are described. A comparison is made between the costs of indoor and outdoor switchyards. Some of the design features of an indoor switchyard at Kalpakkam, Madras are also presented.

54978 BWR availability improvements: programs and progress. Felmus, N.L.; Elhoff, W.C. (General Electric Co., San Jose, CA). *Proc. Am. Power Conf.;* **39**: 208-215(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

At the 1976 American Power Conference General Electric reported on its boiling water reactor (BWR) operating experience in 1975, and described positive programs planned to help utilities improve BWR availability by reducing forced outage rates and the length of refueling and maintenance outages. This paper discusses the results of General Electric's efforts in the past 12 months, and some of its plans for the near future. The remainder of this paper discusses progress made with the Advance Maintenance Planning Serivce (AMPS), as well as other programs that have been in place or recently initiated.

54979 Progress in reducing stress corrosion cracking in BWR piping. Smith, R.E. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.;* **39**: 232-240(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

A description of activities and discussion of progress made in reducing the likelihood for intergranular stress corrosion cracking (IGSCC) in BWR piping systems as a direct result of this program is the subject of this paper. Needs, goals and program structure are discussed, and significant highlights are presented.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 54972, 54973, 55096, 55100, 55103, 55109, 55120, 55125, 55130, 55142, 55149, 55156, 55157, 55158, 55159, 55160, 55169

54980 (COO—2962-5) **Improvement of availability of PWR nuclear plants through the reduction of the time required for refueling/maintenance outages.** Mayers, J.B.; Soth, L.G. (Commonwealth Research Corp., Chicago, IL (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). PWR Systems Div.). Apr 1978. Contract EY-76-C-02-2962. 145p. (WCAP—9215). Dep. NTIS, PC A07/MF A01.

The objective of the project, conducted by Commonwealth Research Corporation and Westinghouse Electric Corporation, is to identify improvements in procedures and equipment which will reduce the time required for refueling/maintenance outages at PWR nuclear power plants. The outage of Commonwealth Edison Zion Station Unit 1 in March through May of 1976 was evaluated to identify those items which caused delays and those work activities that offer the potential for significant improvements that could reduce the overall duration of the outage and achieve an improvement in the plant's availability for power production. Modifications in procedures have been developed and were evaluated during one or more outages in 1977. Conceptual designs have been developed for equipment modifications to the refueling system that could reduce the time required for the refueling portion of the outage. The purpose of the interim report is to describe those conceptual designs and to assess their impact upon future outages. Recommendations are included for the implementation of these equipment improvements in a continuation of this program as a demonstration of plant availability benefits that can be realized in PWR nuclear plants already in operation or under construction.

54981 (NUREG—0103(Rev.2)) **Standard technical specifications for Babcock and Wilcox pressurized water reactors.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jun 1978. 160p. NTIS $14.00.

The Standard Technical Specification (STS) has been structured for the broadest possible use on B and W NSSS plants currently being reviewed for an Operating License. Two separate and discrete containment specification sections are provided for each of the following containment types: Atmospheric, and Dual. Optional specifications are provided for those features and systems which may be included in individual plant designs but are not generic in their scope of application. Alternate specifications are provided in a limited number of cases to cover situations where alternate specification requirements are necessary on a generic basis because of design differences. The format of the STS addresses the categories required by 10 CFR 50 and consists of six sections covering the areas of: Definitions, Safety Limits and Limiting Safety System Settings, Limiting Conditions for Operation, Surveillance Requirements, Design Features, and Administrative Controls.

54982 Rupture protection device for steam generators of substantially cylindrical shape, preferably of pressurized-water nuclear power plants. Mutzl, J. (to Kraftwerk Union AG). US Patent 4,092,215. 30 May 1978. Priority date 30 Sep 1975, German, Federal Republic of (F.R. Germany). 10p.

A rupture protection device is described for a steam generator of substantially cylindrical shape, includes a rupture protection enclosure for surrounding the steam generator, the enclosure including a base, a cover and a jacket formed of tension-resistant and compression-resistant material, and axially stressable connecting means for connecting the base, the cover and the shell to one another, the jacket being formed of substantially cylindrical sections, the cover being formed of a substantially concave divided spherical shell and an undivided bearing ring, the spherical shell having an outer rim surface, the bearing ring being formed with an inner ring surface corresponding to the outer rim surface, the spherical shell being braced as a separate structural member through the outer rim surface thereof against the inner ring surface of the bearing ring, the bearing ring forming part of a bracing assembly including the base, the cover, and the substantially cylindrical jacket through the intermediary of the axially stressable connecting means.

54983 Structural mechanics applied to pressurized water reactor systems. Cloud, R.L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). *Nucl. Eng. Des.;* **46**: No. 2, 273-302(Apr 1978).

From 4. international conference on structural mechanics in reactor technology; San Francisco, USA (5 - 19 Aug 1977).

This paper reviews the application of structural mechanics as practiced today in pressurized water power reactor systems of Westinghouse design. The intent is emphasis of actual practice as opposed to theory review. Emphasis is placed on analysis for accident conditions. Some further research and development needs are discussed.

54984 Axial xenon oscillation model. Onega, R.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mechanical Engineering); Kisner, R.A. *Ann. Nucl. Energy;* **5**: No. 1, 13-19(1978).

A two-point xenon oscillation model was developed for PWRs. The model employs the nonlinear xenon and iodine balance equations and the one group, one-dimensional neutron diffusion equation having nonlinear power reactivity feedback. A two-term spatial harmonic series solution was assumed for the flux, xenon and iodine distributions. The system was made as close to critical as possible with the assumed distributions using a variational principle. The xenon and iodine concentrations were then obtained from their governing differential equations. The input/output nature of the model makes it ideal for simulation of xenon-induced reactor transients. A comparison of the simulated plant to actual plant data was made. The period of oscillation, stability index and flux amplitude of the simulated plant were all found to match the actual plant data with less than 10% error.

54985 Fire protection design for nuclear plants. Brenner, W.B.; Vellender, G.C.; Didier, C.R.; Garrou, A.L. (Fluor Pioneer Inc., Chicago). *Proc. Am. Power Conf.;* **39**: 165-172(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Details are presented for the Fluor Pioneer's Balance of Plant Standard Safety Analysis Report (BOPSSAR) fire protection system.

54986 Operating reliability of Oconee Nuclear Station. Parker, W.O. Jr. (Duke Power Co., Charlotte, NC). *Proc. Am. Power Conf.;* **39**: 180-191(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The principal means for increasing capacity factor are improving the availability of generating units and customer load management, or levelizing peak and off-peak consumption toward base-

load operation. Duke Power Company is engaged in both areas of reliability optimization and consumer load management. The relatively lower fuel costs and comparatively higher capital costs of nuclear plants have focused attention on operating reliability of nuclear generation with emphasis on conservation of natural resources (fossil fuels) and the cost of electricity to the consumer.

54987 **Upgrading of PWRs to enhance plant availability.** Koh, B.; Hamilton, D.E. (Westinghouse Electric Corp., Pittsburgh). *Proc. Am. Power Conf.;* **39**: 192-199(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The cornerstone or WRAP, the Westinghouse Reliability and Availability Program, is the joint development by the utilities and the vendor of upgrading opportunities to improve plant productivity. The changes in systems and components which have been recommended are intended to simplify operation and maintenance or improve operating reliability. The underlying thought is that modifications to improve plant availability must be shown to be cost-effective.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 55109, 55123, 55124, 55125, 55150, 55452

54988 (GA-A—14725) **HTGR nuclear and thermal design verification in Peach Bottom.** Wallroth, C.F.; Saurwein, J.J. (General Atomic Co., San Diego, CA (USA)). Apr 1978. Contract EY-76-C-03-0167-056. 9p. (CONF-780622—50). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

In-pile thermocouple readings and out-of-pile power profile measurements for Peach Bottom driver fuel elements were utilized to verify nuclear and thermal HTGR design code predictions. Time-averaged and end-of-life axial power distributions were established from gamma spectroscopically measured ^{137}Cs, ^{95}Zr, and ^{140}La distributions for fuel elements unperturbed by control rod movements; the comparison with predicted power profiles is shown. Power shape and shift in power peak from the midplane toward the top of the core with depletion were correctly modeled, although the shift in peak was slightly overpredicted. Fuel elements with little or no discernable cesium redistribution were used for the time-averaged profile.

54989 (GA-A—14976) **Leak tightness design basis for HTGR cavity liners.** Grenier, R.M.; Hsieh, R.J.; Pickering, J.L. (General Atomic Co., San Diego, CA (USA)). May 1978. Contract EY-76-C-03-0167-065. 36p. Dep. NTIS, PC A03/MF A01.

The leak tightness design basis for the HTGR cavity liners is presented. A discussion is included of applicable codes and regulations, material qualification requirements, fabrication and examination practices, and leak testing procedures. The operating state and environment of the liner are described, and mechanisms that could potentially cause leakage are evaluated. It is concluded that the high standards of the construction practices combined with a benign operating environment ensure that the liner will maintain leak tightness throughout its operating life.

54990 (K/CSD/INF—77/6) **Multiregional coupled conduction—convection model for heat transfer in an HTGR core.** Giles, G.E. Jr.; Childs, K.W.; Sanders, J.P. (Union Carbide Corp., Oak Ridge, TN (USA). Computer Sciences Div.). 1978. Contract W-7405-ENG-26. 8p. (CONF-780805—5). Dep. NTIS, PC A02/MF A01.

From 6. heat transfer conference; Toronto, Canada (7 Aug 1978).

HEXEREI is a three-dimensional, coupled conduction-convection heat transfer and multichannel fluid dynamic analysis computer code with both steady-state and transient capabilities. The program was developed to provide thermal-fluid dynamic analysis of a core following the general design for high-temperature gas-cooled reactors (HTGRs); its purpose was to provide licensing evaluations for the U.S. Nuclear Regulatory Commission. In order to efficiently model the HTGR core, the nodal geometry of HEXEREI was chosen as a regular hexagonal array perpendicular to the axis of and bounded by a right circular cylinder. The cylindrical nodal geometry surrounds the hexagonal center portion of the mesh; these two different types of nodal geometries must be connected by interface nodes to complete the accurate modeling of the HTGR core. HEXEREI will automatically generate a nodal geometry that will accurately model a complex assembly of hexagonal and irregular prisms. The accuracy of the model was proven by a comparison of computed values with analytical results for steady-state and transient heat transfer problems. HEXEREI incorporates convective heat transfer to the coolant in many parallel axial flow channels. Forced and natural convection (which permits different flow directions in parallel channels) is included in the heat transfer and fluid dynamic models. HEXEREI incorporates a variety of steady-state and transient solution techniques that can be matched with a particular problem to minimize the computational time. HEXEREI was compared with a code of similar capabilities that was based on a Cartesian mesh. This code modeled only one specific core design, and the mesh spacing was closer than that generated by HEXEREI. Good agreement was obtained with the detail provided by the representations.

54991 (ORNL—5412) **Gas-Cooled Reactor Programs. High-Temperature Gas-Cooled Reactor Base-Technology Program. Annual progress report for period ending December 31, 1977.** Homan, F.J.; Kasten, P.R. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 376p. Dep. NTIS, PC A17/MF A01.

Progress in HTGR studies is reported in the following areas: fission product technology and coolant impurity effects, fueled graphite development, PCRV development, structural materials, characterization and standardization of graphite, and evaluation of the pebble-bed type HTR.

54992 (ORNL—5414) **Experimental determinations of the pre- and postirradiation thermal transport and thermal expansion properties of simulated fuel rods for an HTGR.** Moore, J.P.; Godfrey, T.G.; Graves, R.S.; Eatherly, W.P.; Long, E.L. Jr.; Weaver, F.J. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 41p. Dep. NTIS, PC A03/MF A01.

The thermal conductivity, electrical resistivity, coefficient of thermal expansion, volume, and Seebeck coefficient of simulated fuel rods for a high-temperature gas-cooled reactor (HTGR) were measured before and after neutron irradiations to 13.5×10^{25} neutrons/m^2 at nominal irradiation temperatures of 1220 K. These measurements were made as functions of volume percent particle loading, temperature, and neutron fluence. The thermal conductivities decrease with increasing particle loading at all measurement temperatures. The large difference between the properties of specimens from two fabrication processes (extrusion and slug injection) is attributed to the fact that the densities of the continuous phases within the elements differ by a factor of 2.6. Increases in the thermal conductivity with initial neutron fluence of some of the extruded specimens are attributed to partial ordering of carbonaceous material within the composites, but an unambiguous quantitative analysis is difficult. Some electrical resistivity results obtained on slug-injected unirradiated fuel rods show that the thermal conductivity would probably be affected by graphite shim content.

54993 **Arrangement for the support of plate-shaped heat exchanger matrices.** Foerster, S.; Kleemann, M. (to Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). German(FRG) Patent 2,490,052/A/. 18 May 1977. 23p. (In German).

Plate-shaped heat exchanger matrices of high capacity are modified so that they can be used for great mass flows at high differential pressure and temperature, particularly in the gas cooled high temperature nuclear reactor. It is proposed that a large number of heat exchanger matrices connected in parallel should be inserted in a tubular housing, which has a polygonal end plate at one of the outside surfaces, which acts as a support. This carries a number of honeycomb shaped cells, which take the individual heat exchanger matrices. An advantageous configuration of the individual components of the arrangement is described.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 55102

54994 **Rajasthan Atomic Power Reactor Unit-II containment building integrity and leakage test execution experience.** Krishnan, A.; Arya, R.C.; Khanna, R.K. (Rajasthan atomic Power Station, Kota (India)). pp 168-172 of Symposium on operating experience of nuclear reactors and power plants. Bombay; Department of Atomic Energy (1977).

From Symposium on operating experience of nuclear reactors and power plants; Bombay, India (7 Feb 1977).

A pressure and leakage rate test was conducted on Rajasthan-2 Reactor in October, 1975, to prove its structural and containment integrity. The experiences acquired during these tests are reported. The mode of execution and the effort and coordination involved in this gigantic task, conventionally not called upon for this size of concrete building are discussed.

54995 **Operational problems of PHWR type nuclear station in the present day Indian grids.** Narasinga Rao, S.N.; Klra, P.C. (Department of Atomic Energy, Bombay (India). Power Projects Engineering Div.). pp 143-149 of Symposium on operating experience of nuclear reactors and power plants. Bombay; Department of Atomic Energy (1977).

From Symposium on operating experience of nuclear reactors and power plants; Bombay, India (7 Feb 1977).

Operation of 200 MW machines in relatively smaller regional grids such as the ones at Tarapur and Rajasthan, India, poses problems in terms of switchyard hardware and in maintaining the desired quality of frequency and voltages. The conflicting peculiarities of the grid especially in the vicinity of Rajasthan Atomic Power Station (RAPS) and a few incidents affecting the dynamic stability of RAPS generator have been simulated on a computer system and their results presented.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 55122, 55125, 55133, 55150, 55151, 55152, 55161, 55162, 55163, 55484

54996 (ANL/A—78-3) **Study of basic approaches to the design of the primary system of loop-type LMFBRs.** Amorosi, A.; Ahmed, H.; Hutter, E. (Argonne National Lab., IL (USA)). Mar 1978. Contract W-31-109-ENG-38. 250p. Dep. NTIS, PC A11/MF A01.

The report describes the results of a study conducted by an informal "Primary System Study Group" formed at ANL to review from a systems point of view the many possible approaches available to the design of the primary heat transport system for large-size (roughly, 1200 MWe), loop-type LMFBRs. The study is based on examination of the various design options which have been used or proposed to date in the principal loop-type projects and design studies in this country and abroad. The objective of the report is to provide an overview of the approaches which have been considered over the years, to identify and discuss some of their advantages and disadvantages, and, where possible, to indicate which approaches appear to warrant further consideration. The approaches discussed in the report differ principally in: the use of different sizes of reactor vessel--small, with external piping downcomers, or large, with internal downcomers; use of different pump locations--hot leg or cold leg; and, use of different methods for accommodation of system thermal expansion--pipe and elbow loops, special expansion accommodators, free-end pipes, free component movement, and others. The important characteristics, from the systems standpoint, and some particularly pertinent design considerations of the major primary system components are also examined, with emphasis on reactor vessel, pump, and intermediate heat exchanger.

54997 (ANL-CT—78-34) **Coupled shell-side and tube-side heat transfer model for heat exchangers.** Oras, J.J.; Sha, W.T.; Kao, T.T.; Chou, S.L.; Cho, S.M. (Argonne National Lab., IL (USA)). May 1978. Contract W-31-109-ENG-38. 23p. AT.

A heat transfer model coupling the heat transfer of the shell- and tube-side fluids of a sodium-to-sodium heat exchanger is developed. In addition, a difference scheme is suggested for use in computer simulations. Nonuniform tube-side flow distribution is incorporated in the model. Future extension of the model to steam generator applications is made possible by the use of energy equations written in terms of enthalpy.

54998 (COO—2245-41TR) **Flow split measurements in LMFBR blanket assemblies.** Chiu, C.; Todreas, N.E.; Rohsenow, W.M. (Massachusetts Inst. of Tech., Cambridge (USA)). Apr 1978. Contract EY-76-S-02-2245. 136p. Dep. NTIS (US Sales Only), PC A07/MF A01.

Individual subchannel flow rates are isokinetically measured for all the edge and interior subchannels (at a series of Reynolds numbers ranging from laminar to turbulent) in two different LMFBR blanket assemblies. The specific goals of this task are to obtain the average subchannel flow rates for both interior and edge subchannels in the bundle (P/D = 1.067, H/D = 8.0) which is geometrically similar to the blanket assemblies (P/D = 1.077, H/D = 7.7) used in the Clinch River Breeder Reactor and to obtain the information of the lead length effect on the average subchannel flow rates through the subchannel flow rate measurement in the bundle which has P/D = 1.067 and H/D = 4.0.

54999 (COO—2245-43TR) **Mixing experiments in LMFBR wire wrapped blanket assemblies.** Chib, C.; Rohsenow, W.M.; Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge (USA)). Apr 1978. Contract EY-76-S-02-2245. 173p. Dep. NTIS (US Sales Only), PC A08/MF A01.

The saline water injection technique is used to obtain the salt concentration maps at the exits of two LMFBR 61-pin blanket assemblies. The intersubchannel mixing parameter epsilon*/sub 1L/ and the swirl flow parameter C/sub 1L/ which are inputs to the SUPERENERGY (or ENERGY) computer code are reduced from the exit salt concentration maps. Results show that both parameters are independent of the bundle Reynolds number under the high turbulent flow conditions and decrease as the Reynolds number decreases into the laminar flow regime. Both parameters for the four inch lead bundles are less than those for the two inch lead bundle by a factor of 1.8.

55000 (COO—2245-55TR) **Turbulent sweeping flow mixing model for wire wrapped LMFBR assemblies.** Chiu, C.; Rohsenow, W.M.; Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge (USA)). Apr 1978. Contract EY-76-S-02-2245. 69p. Dep. NTIS (US Sales Only), PC A04/MF A01.

A physical model is proposed to derive the sweeping flow for LMFBR triangular array wire-wrapped assemblies under the turbulent flow condition. Two correlations are suggested for the sweeping flow through two different types of gaps between subchannels, the gap between the interior subchannels and the gap between the wall subchannels. These two sweeping flow correlations are evolved by calibrating the constants in the proposed model against the available experimental data. Agreement between the correlations and all the experimental data of +-35 percent is obtained over the assembly design range of 1.315 greater than P/D greater than 1.067 and 52 greater than H/D greater than 4. Based on these correlations, flow sweeping input parameters for two popular computer codes, i.e., COBRA and SUPERENERGY, are recommended.

55001 (COO—2245-56TR) **Flow split model for LMFBR wire wrapped assemblies.** Chiu, C.; Rohsenow, W.M.; Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge (USA)). Apr 1978. Contract EY-76-S-02-2245. 49p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A physical model is proposed to describe the subchannel pressure drop and in turn to derive two correlations for the interior subchannel and edge subchannel average flow rates in wire wrapped LMFBR assemblies. This model takes into account the effects of both the form drag induced by the wires and the skin friction pressure drop induced by the secondary flow in the determination of the interior and edge average subchannel flow rates. As a result, good agreement (+-4%) between the predicted and the experimental subchannel flow rates is obtained for the bundles having the geometric characteristics ranging from P/D—1.067 and H/D = 4.0 to P/D = 1.25 and H/D = 52 over the Reynolds number range 5000 < Re < 73,000. The corner subchannel flow rates are not predicted by the proposed model because experimental data is lacking on the transverse and axial flow in the corner subchannels. However, when this information is available, the proposed model can be expanded to predict the corner subchannel flow rate.

55002 (COO—2826-8) **Fast Breeder Blanket Facility. Quarterly progress report, January 1, 1978—March 31, 1978.** Clikeman, F.M. (ed.). (Purdue Univ., Lafayette, IN (USA). School of Nuclear Engineering). Mar 1978. Contract EY-76-S-02-2826. 39p. (PNE—78-128). Dep. NTIS, PC A03/MF A01.

The work performed in the reporting period was primarily concerned with the continued preanalysis of the first experimental sequence (Task B) and the loading of the first blanket (Task C). Progress on testing experimental equipment and performing checkout tests is also summarized. A comparison of calculated spectra for the original FBBF design, the "as-built" facility, and a large LMFBR is reported. A description of the one- and two-dimensional models used for reaction rate and spectrum calculations are summarized together with a comparison of the results.

55003 (DLCS—5000178) **[Shippingport Atomic Power Station]. Quarterly operating report, first quarter 1978.** (Duquesne Light Co., Shippingport, PA (USA)). 1978. Contract EY-76-C-11-0292. 24p. Dep. NTIS, PC A02/MF A01.

A summary is presented of Shippingport reactor operations. Included are highlights on station performance, coolant chemistry, reactor maintenance, testing program, and health physics. (DG)

55004 (DOE/ET—0050/2) **Performance Measurement System Implementation Guide. RRT Management Control System.** (Department of Energy, Washington, DC (USA). Div. of Reactor Research and Technology). Apr 1978. 113p. (RDD/PMS—2). Dep. NTIS, PC A06/MF A01.

Revision of February 4, 1978.

The document provides uniform guidance for the Reactor Development and Demonstration Division (RDD) and other Energy Research and Development Administration (ERDA) organizations responsible for reviewing and monitoring contractor systems complying with the criteria for cost and schedule control systems of the RDD Performance Measurement System (PMS). Detailed PMS surveillance guidance is provided in RDD/PMS-5, Performance Management System Surveillance Guide. Specific PMS responsibilities of RDD and other participating organizations are stated in

RDD Policy and Procedural Guide No. 26, Application and Implementation of PMS. For the purpose of this guide the term "criteria" is synonymous with the PMS criteria for cost and schedule control systems. The term "performance" is intended to mean "cost/schedule performance."

55005 (DOE/ET—0050/8) **Performance Measurement System Review Team Handbook. RRT Management Control System.** (Department of Energy, Washington, DC (USA). Div. of Reactor Research and Technology). 30 Mar 1977. 116p. (RDD/PMS—8). Dep. NTIS, PC A06/MF A01.

The purpose of the handbook is to provide guidance and reference material for personnel selected to participate in PMS/Mini-PMS implementation activities. It includes procedures and evaluation techniques which have been developed to assist in timely and effective evaluation of a contractor's implementation of the RDD contract performance measurement requirements.

55006 (GEFR—00051(L)-1) **Self-wastage phenomena. Volume I. State-of-the-art data review and evaluation.** Greene, D.A. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Sep 1977. Contract EY-76-C-03-0893-010. 86p. AT.

The report discusses general trends and conclusions which can be drawn from self-wastage data, and supports the evaluation with hypotheses and mechanisms on self-wastage and defect plugging phenomena. The data base is used to provide preliminary estimates of the magnitude of self-wastage phenomena, their impact on leak detection criteria, and possible criteria and guidelines for the plant operator. Chemical leak detectors were evaluated against the self-wastage data. They provide significant, but limited, protection against defects in the steam generators. Such detectors will indicate the presence of defects which have an initial size in the range 0.025 to 0.10 mm equivalent hydraulic diameter (0.001 in. to 0.004 in.). If the defect is initially smaller than 0.025 mm diameter and in the superheater (460°), it is probable that the defect will grow into a hole of approximately 3 mm diameter prior to unit shutdown following detection and operator action. All defects with initial size below 0.2 mm (0.008 in.) in the evaporator (340°C) will probably be detected with time to take action. Acoustic leak detectors were also evaluated. They appear to have the potential for increased detection range compared to chemical detectors, but are in an early stage of development. Acoustic detectors have the potential added capability of location of the defect.

55007 (GEFR—00279(L)) **Preliminary self wastage test results from CRACKPOT facility.** Gudahl, J.A.; Hunsicker, J.C.; Gerrels, E.E. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Sep 1977. Contract EY-76-C-03-0893-010. 38p. AT.

This preliminary report presents results of the microdefect self-wastage tests conducted in the new CRACKPOT facilities as of September 1977. Twelve tests were completed; three additional tests are in progress. Complete self-wastage penetration of the tube wall (e.g., defect enlargement) occurred in three cases at 900°F (482°C), three at 650°F (343°C), and one at 580°F (304°C). In three tests at 580°F and one test at 650°F, the leak rate remained below the initial rate during the entire test. Complete penetration was not achieved in one test at 650°F prior to test termination. All three of the continuing microdefect tests, at 650°F, are in a plugged condition.

55008 (GEFR—00322) **Friction, wear, and fretting: Clinch River Breeder Reactor steam generators.** Hartle, R.T.; Ring, P.J. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Apr 1978. Contract EY-76-C-03-0893-030. 66p. AT.

Steam generator tubing is subject to fretting, wear and galling due to movement of the tubing relative to the spacer plates. Testing was performed to determine the degree of wear likely for 2¼Cr—1Mo under Clinch River Breeder Reactor Steam Generator conditions.

55009 (JAERI-M—7139) **Adequacy of the analysis of mock-up control rod experiment with FCA.** Mizoo, N.; Nakano, M. (Japan Atomic Energy Research Inst., Tokyo). Jul 1977. 33p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

A method of numerical analysis has been investigated for the mock-up control rod experiment of FCA VII-1 assembly constructed as the engineering mock-up of prototype fast breeder reactor MONJU. The results of criticality and B_4C mock-up control rod worths analysis for the assembly are described in comparison with the experimental ones. The tendency of the C/E value with ^{10}B enrichment and the interaction effect of the multiple rods array was also examined. Reactivities and the mock-up rods worths were obtained with the X-Y geometry six groups diffusion theory. Twelve kinds of the mock-up rods with different ^{10}B contents and/or enrichments were used in the experiment; effective cross-sections are provided for each rod by calculation using the collision probability method. Criticality of VII-1 90Z assembly is underestimated for 3 reference critical configurations, ranging from -0.65%Δk/k to -0.77%Δk/k. The C/E values at core center for 12 kinds of B_4C mock-up rods range from 1.03 to 1.09. The overestimate of the rod worth increases with macroscopic absorption cross-section of the rod region. The C/E values for 24 different arrays of the mock-up rods ranging from single rod to five rods lie between 1.04 and 1.08. The C/E value tends to decrease with increase in the number of rods inserted, the values for five rods arrays being about 4% lower than those for single rod arrays. The calculated interaction effects of the multiple rods arrays are slightly more negative than the experimental ones.

55010 (NEDM—14150) **Thermal/hydraulic test results including critical heat flux conditions for a sodium-heated steam generator tube model.** Wolf, S.; Holmes, D.H. (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Sep 1976. Contract EY-76-C-03-0893-010. 56p. AT.

Thermal/hydraulic tests were performed with a sodium-heated water-steam tube prototypic of a CRBRP steam generator tube section. The test section was designed and is being used for DNB Effects testing to support engineering development of the CRBRP steam generators. The experimental ranges were: pressure, 1590 to 1890 psia (11.0 to 13.0 MPa); mass flux, 0.97 to 2.39 10^6 lbm/hr-ft^2 (4.74 to 11.7 10^6 kg/hr-m^2); critical heat flux, 0.21 to 0.44 10^6 Btu/hr-ft^2 (0.66 to 1.39 MW/m^2); and critical quality, 0.23 to 0.40. The thermal/hydraulic results of this test are analyzed and presented in this report. Specific results include: evaluation of critical steam quality correlations, determination of the length of the transition boiling region, and preliminary evaluation of tube wall thermal conductivity.

55011 (TID—3333-S5) **Liquid metal fast breeder reactors. A bibliography, January—December 1977.** Galde, D.O. (comp.). (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). May 1978. 518p. Dep. NTIS, PC A22/MF A01.

Included are 2334 abstracts of LMFBR references compiled from the DOE Energy Information Data Base (EDB) covering the period January 1977 through December 1977. Corporate, Personal Author, Subject, and Report Number Indexes are provided. (DG)

55012 (TID—28546) **Suitability of 2—1/4Cr—1Mo steel for LMFBR Steam Generation System applications: a critique of NUREG-0387.** Spalaris, C.N. (comp.). (General Electric Co., San Jose, CA (USA). Fast Breeder Reactor Dept.). 1 May 1978. Contract EY-76-C-15-1200. 59p. AT.

Responses of industry representatives to a report which questioned the suitability of 2¼ Cr-1 Mo steel for LMFBR steam generators are presented. The responses reendorse the choice of 2¼ Cr-1 Mo steel for steam generator applications.

55013 (WARD-OX—3045-39) **Breeder reactor grid-type subassembly design and evaluation. Quarterly progress report for the period ending December 31, 1977.** (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Apr 1978. Contract EY-76-C-02-3045-008. 20p. AT.

Studies on LMFBR grid-type fuel assembly mechanical design include ductless core design and the fabrication, development, and testing of assemblies. Objectives, prior work, and current progress in these studies are summarized.

55014 **Liquid-metal fast breeder reactor fuel rod performance and modeling at high burnup.** Verbeek, P. (Belgonucleaire, Brussels); Toebbe, H.; Hoppe, N.; Steinmetz, B. *Nucl. Technol.;* **39**: No. 2, 167-185(Jul 1978).

The fuel rod modeling codes IAMBUS and COMETHE were used in the analysis and interpretation of postirradiation examination results of mixed-oxide fuel pins. These codes were developed in the framework of the SNR-300 research and development (R and D) program at Interatom and Belgonucleaire, respectively. SNR-300 is a liquid-metal fast breeder reactor demonstration plant designed and presently constructed in consortial cooperation by Germany, Belgium, and the Netherlands. RAPSODIE I, the two-bundle irradiation experiment, was irradiated in the French test FBR RAPSODIE FORTISSIMO and is one of the key irradiation experiments within the SNR-300 R and D program. The comparison of code predictions with postirradiation examination results concentrates on clad diameter expansions, clad total axial elongations, fuel differential and total axial elongations, fuel restructuring, and fission gas release. Fuel rod modeling was considered in the light of benchmarking of the codes, and there was consideration of fuel rod design for operation at low and high burnup.

55015 **Effect of prior irradiation creep on the subsequent burst strength of 20% cold-worked type 316 stainless-steel cladding.** Duncan, D.R. (Hanford Engineering Development Lab., Richland, WA). *Nucl. Technol.;* **39**: No. 2, 199-206(Jul 1978).

Creep rates of metals can be greatly enhanced by neutron irradiation experienced in a fast reactor environment. Because irradiation-induced creep strains can be large in magnitude for duct and cladding components, the effect of irradiation creep on subsequent

mechanical property behavior must be quantified to provide a design base for core component performance assessment. Pressurized tubes that had sustained a peak value of irradiation creep strain of 1.04% and peak fast fluences of 10 x 10^{22} n/cm^2 under irradiation in the Experimental Breeder Reactor II from 650 to 857 K were tested in subsequent transient burst loading. Results of testing show that subsequent deformation is unaffected by prior irradiation creep within experimental error.

55016 Hydrogen burden from the steam side corrosion in sodium-heated steam generators. Roy, P.; Rodgers, D.N. (General Electric Co., San Jose, CA). *Nucl. Technol.;* **39**: No. 2, 213-215(Jul 1978).

It has been observed that in sodium-heated steam generators most of the hydrogen produced from water- or steam-side corrosion permeates into the secondary sodium. The amount of hydrogen that diffuses into the secondary side is extremely important from the standpoint of the design of the cold trap, hydrogen background levels, and tritium concentrations in the secondary system. We have compiled all the available data on H_2 permeation from all operating sodium-heated steam generators. In addition, based on the available steam-side corrosion data, we have made tentative recommendations: Steady-state H_2 flux, (1) Evaporator (2¼ Cr—1 Mo)—1.8 to 2.2 x 10^{-11} g H/cm^2.s. (2) Superheater (2¼ Cr—1 Mo)—1.2 to 1.7 x 10^{-11} g H/cm^2.s. Initial H_2 flux (up to 2000 h): Evaporator and superheater (2¼ Cr—1 Mo)—approximately 7 to 8 x 10^{-11} g H/cm^2.s.

55017 Electrochemical oxygen sensor for measurement of oxygen in liquid sodium. Roy, P.; Bugbee, B.E. (General Electric Co., San Jose, CA). *Nucl. Technol.;* **39**: No. 2, 216-218(Jul 1978).

The results obtained from approximately 4000 h of operation of an electrochemical oxygen meter developed at General Electric Company for measuring oxygen activities in liquid sodium are described. In the present design, a small ceramic cup (ThO_2 with 7 to 8 wt % Y_2O_3) has been brazed to a metal tube that is inserted into the liquid sodium via a standard sodium flange. The reference electrode used in the present design consists of In/In_2O_3. Several meters were tested in a flowing sodium system, where the oxygen concentrations were controlled by a cold trap. At 500°C, the oxygen electromotive force (emf) output can be expressed as emf/sub (V)/ = 0.269 + (160/T) (+-0.003 V), where T is the cold-trap temperature in K. The temperature coefficient of the meters can be expressed as (dE/dT) = 0.51 +- (0.02) mV/°C.

55018 Apparatus and method for thermal power generation. Cohen, P.; Redding, A.H. (to Westinghouse Electric Corp.). US Patent 4,087,985. 9 May 1978. Filed date 17 Mar 1976. 8p.

An improved thermal power plant and method of power generation is described which minimizes thermal stress and chemical impurity buildup in the vaporizing component, particularly beneficial under loss of normal feed fluid and startup conditions. The invention is particularly applicable to a liquid metal fast breeder reactor plant.

55019 Status report on ultrasonic testing of austenitic welds. Herberg, G.; Laufer, W. *Materialpruefung:* **20**: No. 3, 120-124(Mar 1978). (In German).

Experience in the field of austenite systems has shown that surface and irradiation testing are not sufficient on their own to judge welded joints. Particularly in consequence of the development of Na-cooled breeder reactors, it appears necessary to demand the same expenditure for fabrication and iterative tests as for ferrite components for light water reactors (LWR). As the primary and secondary circuit components of Na breeders are fabricated from austenite materials, the ultrasonic (US) testing must also be adapted to the coarse - grained directional solidifying microstructure of austenite welded seams. World-wide development works are being carried out on this subject. The procedure here is not uniform.

55020 Rupture disc. Newton, R.G. (to Energy Research and Development Administration). US Patent 4,064,003. 20 Dec 1977. Filed date 29 Mar 1976. 6p.

PAT-APPL-671,912.

The intermediate heat transport system for a sodium-cooled fast breeder reactor includes a device for rapidly draining the sodium therefrom should a sodium-water reaction occur within the system. This device includes a rupturable member in a drain line in the system and means for cutting a large opening therein and for positively removing the sheared-out portion from the opening cut in the rupturable member. According to the preferred embodiment of the invention the rupturable member includes a solid head seated in the end of the drain line having a rim extending peripherally therearound, the rim being clamped against the end of the drain line by a clamp ring having an interior shearing edge, the bottom of the rupturable member being convex and extending into the drain line. Means are provided to draw the rupturable member away from the drain line against the shearing edge to clear the drain line for outflow of sodium therethrough.

55021 Nuclear reactor. Bittermann, D.; Goetzmann, C.; Hassmann, K.; Preuss, H.J.; Rau, P.; Schatz, M. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,234,782/B/. 3 Nov 1977. 5p. (In German).

The object of the invention is to ensure a sufficient removal of heat in the case of an accident involving a core melt of a nuclear reactor - in particular a breeder reactor. A cooled tank to catch the melted core is inside the containment under the reactor core. According to the invention, there is a coolant pipeline from this tank to the containment serving as heat exchanger. The cooling of the containment (of metal) used as heat exchanger is further imporved upon by a series of measures. 12 subclaims.

55022 Tertiary heat exchanger. Hahn, G. (to Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). German(FRG) Patent 2,550,329/A/. 18 May 1977. 9p. (In German).

The invention deals with the improvement of a tertiary heat exchanger possessing a contact medium besides a heating and working medium. These kind of heat exchangers are used in sodium-cooled nuclear power plants. The contact medium used so far should be reploced by a metal granulate which is used in porous bulk of single grains of varying size. It is advantageous to use copper as granulate.

55023 Mixed fuel cycle hybrid LMFBR cores: design and analysis. Shenoy, S.K. Gainesville, FL; Univ. of Florida (1977). 206p. University Microfilms Order No. 78-10,984.

Thesis (Ph. D.).

The positive sodium-void reactivity effects in large Liquid Metal Cooled Fast Breeder Reactors (LMFBRs) may be reduced substantially if the (Pu—^{238}U) fuel cycle is replaced by the (^{233}U—Th) fuel cycle in the center portion of the cores. Geometric spoiling methods, e.g., reducing the core height-to-diameter ratio, also achieve the same end. Both methods lead to economic penalties in the form of reduced breeding ratio (B.R.) and increased doubling time (D.T.). In this work the relative merits of the two methods of reducing the positive sodium-void reactivity-effect are compared. The calculations show that for comparable improvements in the sodium-void reactivity effect, the economic penalty for using a central core region of (^{233}U—^{238}U) fuel is smaller than for using a flattened core.

55024 Status of Prototype Large Breeder Reactor (PLBR) designs. Minnick, L.E. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.;* **39**: 152-155(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The background and current developments relating to the PLBR reactor are reviewed.

REGULATION AND LICENSING

REFER ALSO TO CITATION(S) 55252

55025 (NTISUB/D—142/001) **Nuclear Regulatory Commission issuances.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Administration). Jan 1978. 156p. NTIS $4.75.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LPB), and the Administrative Law Judge.

55026 (NUREG—0020(Vol.2)(No.6)) **Licensed operating reactors. Operating units status report, data as of 5-31-78.** (Department of Energy, Washington, DC (USA); Nuclear Regulatory Commission, Washington, DC (USA)). Jun 1978. 271p. NTIS.

The report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices and IE Headquarters; and the third section is an appendix containing comparative statistics of U.S. nuclear/fossil capacity, identification of nuclear power plants within regional Electric Reliability Councils, the relative status of U.S. nuclear electric production by state, and selected Edison Electric Institute operating statistics.

55027 (NUREG—0030(Vol.1)(No.6)) **Nuclear power plants. Construction status report, data as of May 31, 1978.** (Department of Energy, Washington, DC (USA); Nuclear Regulatory Commission, Washington, DC (USA)). Jun 1978. 192p. NTIS.

Data on the construction status of U.S. nuclear power plants as of May 31, 1978 are presented. Included are data on licensing activities affecting construction as well as detailed information on construction activities and schedules. (DG)

55028 (RDT-E—15-2NC-T(6-78)) **Class 2 nuclear components (supplement to ASME Boiler and Pressure Vessel Code, Section III, Subsections NCA and NC).** (Department of Energy, Washington, DC (USA). Div. of Nuclear Power Development). Jun 1978. Contract W-7405-ENG-26. 34p. RSO.

This standard supplements the rules for the construction of nuclear components that are covered by Subsections NCA and NC of the 1977 Edition of the ASME Boiler and Pressure Vessel Code (the Code), Section III. When this standard is invoked or referenced, the applicable subsections of Section III of the Code are also invoked or referenced. The user is responsible for obtaining and applying the edition and revisions of this standard that supplement the edition and Addenda of the Code that are in legal effect at the time of use.

55029 (RDT-E—15-2ND-T(6-78)) **Class 3 nuclear components (supplement to ASME Boiler and Pressure Vessel Code, Section III, Subsections NCA and ND.** (Department of Energy, Washington, DC (USA). Div. of Nuclear Power Development). Jun 1978. Contract W-7405-ENG-26. 15p. RSO.

This standard supplements the rules for the construction of nuclear components that are covered by Subsections NCA and ND of the 1977 Edition of the ASME Boiler and Pressure Vessel Code (the Code), Section III.

55030 Nuclear regulation. Stello, W. Jr. (Nuclear Regulatory Commission, Washington, DC). *Proc. Am. Power Conf.;* **39**: 115-119(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The role of the US NRC in regulating nuclear power plants is reviewed. Current areas of specific interest include fire protection, reactor safeguards, and the development of a systematic evaluation program.

55031 Nuclear regulation: the industry point of view. Ward, J.E. (Sargent and Lundy, Los Angeles). *Proc. Am. Power Conf.;* **39**: 120-126(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Problems related to the licensing and regulation of nuclear power plants in the U.S. are discussed.

55032 Impact of Nuclear Regulatory Commission regulations on fire protection for nuclear plants. Hayden, L.E. (Brown and Root, Inc., Houston, TX); Scott, D.B.; Sumpter, J.R. *Proc. Am. Power Conf.;* **39**: 127-131(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

One of the most significant areas of activity by regulatory agencies during the past few years concerns fire protection in nuclear power-generating facilities. This paper traces the evolution of the requirements, and discusses the impact these requirements are having on design, costs and schedules.

55033 Meeting the latest qualification requirements for class IE protection system equipment: a practical approach. Daigle, R.P. (Combustion Engineering, Inc., Windsor, CT); Breen, R.J. *Proc. Am. Power Conf.;* **39**: 132-140(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The requirements for qualifying Class 1E equipment for Nuclear Power Generating Stations were significantly revised in 1974 and 1975. The Nuclear Regulatory Commission is presently requiring utilities to comply with these revised standards and regulatory guides in order to obtain the necessary permits. Manufacturers are developing and implementing programs to comply with the new requirements. One of the more difficult new requirements of qualification is aging to achieve advanced life condition. The objectives and methods described for aging are difficult for much of the equipment within the Protection System. This paper deals with solutions for qualification in a practical sense, with emphasis on the aging issue and does not elaborate on seismic or environmental qualifications.

55034 Pollution-abatement regulations for nuclear power stations and their economic impact. Scott, F.M.; Mayenkar, K.V. (Harza Engineering Co., Chicago). *Proc. Am. Power Conf.;* **39**: 141-151(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The United States EPA, on October 8, 1974, published the final effluent guidelines and standards for discharges from steam electric generating plants. This paper contains a discussion of the BPCTCA and BATEA limitations for thermal and chemical effluent discharges from a nuclear steam electric power generating station and a review of the process technology available for pollution abatement. Both existing technology and technology currently under development are reviewed.

ECONOMICS

REFER ALSO TO CITATION(S) 55254

55035 (CONF-780710—3) **Power plant capital cost estimating using the CONCEPT-5 computer code.** Hudson, C.R.; Bowers, H.I. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 12p. Dep. NTIS, PC A02/MF A01.

From 22. American Association of Cost Engineers meeting; San Francisco, CA, USA (9 Jul 1978).

The CONCEPT-5 computer code, which is publicly available, produces conceptual capital cost estimates for light water reactor and coal-fired power plants in the United States at any point in time. The code, based on the premise that any central station power plant involves approximately the same major cost components regardless of location or date of initial operation, has detailed cost models for each plant type at a reference condition. Through the use of size, time, and location dependent cost adjustments, a reference cost model is modified to produce a specific capital cost estimate. The user has flexibility in selecting many variables, including plant type, schedule, size, number of units, location, interest and escalation rates. Discussed will be the methodology used in the code, the input and output options available to the user, as well as specific capital cost estimates for nuclear and coal-fired power plants.

55036 Study of electrical energy demand, supply alternatives, and nuclear options, 1975 through 2025. Hoskins, R.E. Chattanooga; Tennessee Valley Authority (1977). 66p.

Electrical energy demand forecasts for the period 1975 through 2025 are discussed and the possible nuclear options for meeting these demands are analyzed. The options considered included LWR with and without recycle, LWR/LMFBR in tandem, stagnation at the current planned capacity, and abandonment of nuclear power. Full resources and costs are considered as well as power and economic costs.

55037 Economics of nuclear power. Rossin, A.D.; Rieck, T.A. (Commonwealth Edison Co., Chicago). *Science;* **201**: 582-589(18 Aug 1978).

The performance of nuclear power in the U.S. is evaluated by comparing its economic record with that of alternative sources of electricity. The available electric energy supply options for the late 1980's are also evaluated.

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 54295, 54758

NUCLEAR REACTOR TECHNOLOGY

55038 (DOE/IR—0011) **Nuclear engineering enrollments and degrees, 1977. Enrollments-Fall 1977; degrees granted July 1966—June 1977.** (Department of Energy, Washington, DC (USA). Div. of Labor Affairs and Manpower Assessment). 1977. 73p. Dep. NTIS, PC A04/MF A01.

This report presents the results of the seventh annual survey of Nuclear Engineering Enrollments and Degrees. Each year the survey is sent to institutions offering degrees in nuclear engineering or other engineering disciplines with nuclear engineering options. The number of institutions included may vary from one year to the next as new programs are identified and other programs are discontinued. However, historical information about degrees granted since 1966 has been collected for all institutions. Enrollments and degrees granted by region and state are presented for the first time.

55039 (EPRI-NP—773) **Uprated dc power system and thermal-hydraulic facilities at Columbia University. Final report.** Hovemeyer, W.E.; Sreepada, S.R.; Casterline, J.E. (Columbia Univ., New York (USA). Dept. of Chemical Engineering). Apr 1978. 102p. Dep. NTIS, PC A06/MF A01.

The necessity of carrying out large scale nuclear thermal-hydraulic simulations is increasing. Such experiments call for large power sources, and to meet those requirements the D.C. power system at the Heat Transfer Research Facility of Columbia University has been upgraded to 11.5 MW. The uprated system, its installations, various subsystems, and operations are described. The thermal-hydraulic loops and their auxiliary systems which are supported by the D.C. power system are also described.

55040 (TID—28368) **Quality assurance engineering for nuclear and other complex facilities.** Bohannon, J.R. Jr. (North Carolina State Univ., Raleigh (USA). Dept. of Nuclear Engineering). 1 Mar 1978. Contract EY-6-S-05-4760. 496p. Dep. NTIS, PC A21/MF A01.

An instructional treatise on quality assurance as applied in the nuclear industry is presented in a format suitable for use as a senior level course for engineering students.

55041 (JPRS—71066) **Translations on Eastern Europe. Scientific Affairs No. 581.** 5 May 1978. Translation of various papers. 46p. NTIS.

The serial report contains articles concerning the development of and progress in the various theoretical and applied scientific disciplines and technical fields; and the administration, structure, personnel, and research plans of leading East European scientific organizations and institutions, particularly the academies of sciences. Two articles were separately processed for the Energy Data Base. (DG)

55042 (JPRS—71066, pp 26-32) **Status of nuclear power research, perspectives.** Berenyi, D. 5 May 1978. Translated from Magyar Tudomany; No. 12, 893-907(1977).

In Translations on Eastern Europe. Scientific Affairs No. 581.

Brief comments are presented on reactor technology studies being carried out in Hungary, including reactor kinetics, reactor instrumentation, reactor operation, reactor control optimization, reactor safety, radiation protection, and fuel cycle. (DG)

55043 **Modern technologies as a result of materials, construction, production and quality control, as illustrated by the example of nuclear facilities.** Mayinger, F. *VDI (Ver. Dtsch. Ing.) Z.;* **119**: No. 20, 986-993(Oct 1977). (In German).

In the case of nuclear reactors the technical design as regards safety plays a leading role. By means of simple examples of the constructive arrangement of gas and water cooled reactors, the technical safety measures applied in connection with construction, production and quality testing are dealt with briefly.

THEORY AND CALCULATION

55044 (PB—277830) **Snake: a solid angle calculational system. Technical report.** Thompson, J.K.; Lewallen, M.A.; Trapp, T.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1978. 31p. NTIS PC A03/MF A01.

A computer code, SNAKE (Solid Angle Calculational System For Neutron Interaction And Array K-effective Estimation), has been developed for the calculation of solid angles subtended by geometric forms composed of spherical, cylindrical, and planar surfaces, either singularly or in specified arrays, from exact analytic integral forms. This basic capability is used to provide information necessary for the solid angle method for evaluation of neutron interaction in arrays. This document outlines the methodology and use of the code.

55045 (PB—278013) **Critique of the solid angle method. Technical report 1 Jul 75-30 Sep 77.** Oden, D.R.; Thompson, J.K.; Lewallen, M.A.; Trapp, T.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1978. 58p. NTIS PC A04/MF A01.

The solid angle method provides an approximation for nuclear criticality safety analyses for fissile arrays. It was formulated for use with highly-enriched systems. This study was initiated to determine applicability of this method to low-enriched uranium systems, using as a standard for comparison analyses the KENO-IV code and the Hansen-Roach cross sections. The report identified many conditions for which a margin of safety does exist, using the solid angle method. The study also determined that some applications exist for which a safety margin does not exist, using common criteria, and has recommended additional criteria needed to assure safety margins. These additional criteria have not been tested extensively to assure generic applicability.

55046 **Reactor physics experiments in power reactors. 2. Determination of reactivity effects during power-level operation.** Frach, K.H.; Greiner-Mai, H. (VEB Kernkraftwerk Bruno Leuschner, Greifswald (German Democratic Republic). Betriebsteil Kernkraftwerk Rheinsberg). *Kernenergie;* **21**: No. 5, 125-128(May 1978). (In German).

Measuring and evaluation methods applied in reactor physics to the continuous operation of power reactors are reviewed. Significance and validity of the results of such measurements are outlined.

55047 **Correlations for calculating the heat transfer of single rows of tubes and tube bundles in cross-flow.** Gnielinski, V. (Karlsruhe Univ. (TH) (Germany, F.R.). Inst. fuer Thermische Verfahrenstechnik). *Forsch. Ingenieurwes.;* **44**: No. 1, 15-25(1978). (In German).

Correlations are developed for the calculation of mean heat transfer coefficients of single rows of tubes and tube bundles in cross-flow. They are tested by a great number of data for gases and liquids from the literature. The new correlations are based on an equation for the heat transfer in fluid flow normal to a single cylinder, which was published earlier.

55048 **Application of the higher-order prompt-jump approximation to the numerical solutions of the reactor kinetics equations.** Blenski, T. (Institute of Nuclear Research, Swierk (Poland). Computing Centre). *Atomkernenergie;* **31**: No. 4, 232-237(1978).

The higher-order prompt-jump approximation in the reactor kinetics is derived using the technique developed by Goldstein and Shotkin. The role of the fast changing parts of the solutions is investigated and the shifted initial conditions for the nonstiff asymptotic equations are obtained. A modified algorithm based on this approximation is tested for some reactivity inputs and three reactor cases. The results show the sufficient accuracy of the low-order approximations.

55049 **Stochastically perturbed nonlinear point reactor model.** Karmeshu (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Theoretische Physik). *Ann. Nucl. Energy;* **5**: No. 1, 21-25(1978).

An exact analysis is presented of the fluctuations of neutron density in a stochastically perturbed nonlinear point reactor model in the absence of delayed neutrons. The reactivity and feedback coefficients are assumed to have white noise Gaussian component. The time development of probability distribution is obtained from the Fokker-Planck equation. It is found that for small density of neutron population the stationary probability distribution is more sensitive to the random change in the reactivity than in the feedback coefficient, whereas for large neutron density the probability distribution is more sensitive to the random change in the feedback coefficient than in the reactivity.

55050 **Analysis of selected fast critical experiments using recent delayed neutron yield evaluations.** Krishnan, S.; Sharma, M.L.; Lee, S.M. (Reactor Research Centre, Kalpakkam (India)). *Atomkernenergie;* **31**: No. 3, 146-150(1978).

Several new measurements and evaluations of the delayed neutron parameters of fissile and fertile nuclides have been made in recent years. A comparison is made of three recent evaluations through the analysis of ten fast critical assemblies. The main parameters used for the comparison are the effective delayed neutron fractions and the experimentally measured central reactivity worths of various materials. It is found that though there are appreciable differences with respect to the classical data of Keepin there is not much difference between the recent evaluations among themselves.

55051 **Reactor noise theory as a Markov process.** Lewins, J. (London Univ. (UK)). *Atomkernenergie;* **31**: No. 4, 223-226(1978).

The low power stochastic equations for neutron multiplicatkon in the 'lumped' model (reactor noise) are developed as standard Kolmogorov forward and backward equations to show the connection with conventional generating function treatment.

55052 **Second-order functionals for spectral synthesis with discontinuous trial functions.** Mitra, A.K.; Nelson, P. (Texas Tech Univ., Lubbock (USA)). *Ann. Nucl. Energy;* **5**: No. 1, 27-34(1978).

As an extension of earlier work, the most general second-order variational functional for the two-region multigroup neutron diffusion problem has been derived from the Generalized Roussopoulos Principle. Several special cases of this general functional have been identified with second-order functionals previously proposed in the literature. A theorem on the equivalence of the first-and second-order synthesis has been proved under certain assumptions. This theorem provides a criterion for discriminating between the pure first-order and pure second-order cases. It is evident that the second-order synthesis is advantageous over the first-order, because one has to choose fewer trial functions. Some numerical results, based on the pure first-and pure second-order synthesis, for a prototype two-region two-group reactor model have been given. For the purpose of illustration, two special cases, viz. Galerkin weighting and unity weighting, for the choice of adjoint trial functions for the second-order synthesis have been considered.

55053 **Calculation of buckling variation due to coupling of cores.** Rabitsch, H. (Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik). *Atomkernenergie;* **31**: No. 4, 227-231(1978).

The change of the buckling induced by coupling of two cores having the shape of annular sectors is calculated. At first an integral representation of the neutron flux in the coupling region depending on the values of the flux and of the derivative of the Green function at the interface between the regions is derived in the framework of one group diffusion theory. These integrals are evaluated asymptotically for large radii and for approximate expressions of the boundary fluxes. The approximate solutions so obtained are used in a first

order perturbation theory to determine the change of the buckling of the two coupled cores. It turns out that this change depends strongly on the nuclear properties of the coupling medium. This change of buckling may be used to estimate the influence of changes of any geometrical or nuclear parameter of the system upon the multiplication constant.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 55033, 55165, 55166, 55174, 55502, 55503, 55777

55054 (EPRI-NP—838) **BIGIF: fracture mechanics code for structures. Manual 1. Introduction and theoretical background.** Besuner, P.M.; Peters, D.C.; Cipolla, R.C. (Failure Analysis Associates, Palo Alto, CA (USA)). Jul 1978. 43p. Dep. NTIS, PC A03/MF A01.

The fracture mechanics approach to structural reliability accepts that some flaws will be present, but that conditions can be established to assure that flaws do not grow to an unacceptable size during the life of the structure. Fracture mechanics life prediction requires calculation of crack tip stress intensity factors to quantify both stable crack growth and the conditions for unstable fracture in complex geometries under complex elastic loading conditions which lead to high stress gradients. The BIGIF computer code has been developed to perform accurately and inexpensively these life predictions for a wide range of two- and three-dimensional stress fields and cracks and structural geometries, given that the elastic stress solution for the uncracked structure is available from another independent source. This general description manual is the first of three manuals documenting BIGIF. This first manual is designed to provide a general understanding of the program capabilities and enough information to decide whether or not to use BIGIF. The second and third manuals provide more detailed information and serve as user and programmer guides, respectively.

55055 (NUREG/CR—0113) **Half-bead (temper) repair welding for heavy-section steel technology program vessels.** Wismer, S.W.; Holz, P.P. (Oak Ridge National Lab., TN (USA)). 18 May 1978. Contract W-7405-ENG-26. 129p. (ORNL/NUREG/TM—177). Dep. NTIS, MF A01.

Portions of document are illegible.

The "half-bead (temper) welding technique" performed to Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code guidelines was used successfully on cavities placed in three thick-walled pressure vessel models to simulate repair welding of operational nuclear reactor vessels. One of the models served as a qualification-procedure test specimen, as required by the Code, and was subsequently utilized for detailed metallurgical examinations. The temper-, or half-bead, technique, in theory, is structured such that each weld pass is applied in a manner which results in tempering the preceding weld pass. Thus, brittle transformation products created during welding will be rendered ductile. Conventional postweld thermal stress relief is not required. The repair welding was performed on 152.4-mm-thick low-alloy steel vessel material (ASME SA-533, grade B, class 1) in the vertical position, using 2.4-mm-diam type 8018-C3 electrodes for the first layer and 3.2-mm-diam electrodes of the same type for subsequent passes and for completing the weld. After welding, a low-temperature temper treatment, or postweld heat treatment (PHWT), was performed for 4 hr. Routine magnetic-particle inspections were conducted for each of the first three weld passes and thereafter on alternate passes. Final nondestructive repair inspections were made a minimum of 48 hr after the vessels had cooled to ambient temperature. Magnetic-particle surface inspections and ultrasonic inspections of the repairs revealed no indications of any delayed cracking. A second ultrasonic inspection of one of the vessel repairs by ORNL approximately 12 weeks after postrepair welding also revealed no indications of delayed cracking. Final ultrasonic and radiographic test results were acceptable for all repair welds.

55056 Some in-reactor loop experiments on corrosion product transport and water chemistry. Balakrishnan, P.V.; Allison, G.M. (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Nucl. Technol.;* **39**: No. 2, 105-120(Jul 1978).

A study of the transport of activated corrosion products in the heat transport circuit of pressurized water-cooled nuclear reactors using an in-reactor loop showed that the concentration of particulate and dissolved corrosion products in the high-temperature water depends on such chemical parameters as pH and dissolved hydrogen concentration. Transients in these parameters, as well as in temperature, generally increase the concentration of suspended corrosion products. The maximum concentration of particles observed is much reduced when high-flow, high-temperature filtration is used. Filtration also reduces the steady-state concentration of particles. Dissolved corrosion products are mainly responsible for activity accumulation on surfaces. The data obtained from this study were used to estimate the rate constants for some of the transfer processes involved in the contamination of the primary heat transport circuit in water-cooled nuclear power reactors.

55057 Radiation shield for nuclear reactors. Weissenfluh, J.A. US Patent 4,090,087. 16 May 1978. Filed date 8 Sep 1976. 6p.

A shield for use with nuclear reactor systems to attenuate radiation resulting from reactor operation is described. The shield comprises a container preferably of a thin, flexible or elastic material, which may be in the form of a bag, a mattress, a toroidal segment or toroid or the like filled with radiation attenuating liuid. Means are provided in the container for filling and draining the container in place. Due to its flexibility, the shield readily conforms to irregularities in surfaces with which it may be in contact in a shielding position.

55058 (JPRS—71066, pp 33-40) **Nuclear physics research to promote power production.** Berenyi, D. 5 May 1978. Translated from Magyar Tudomany; No. 12, 924-934(1977).

In Translations on Eastern Europe. Scientific Affairs No. 581.

Brief comments are presented on nuclear power-related studies carried out by the Hungarian Nuclear Research Institute (ATOMKI). (DG)

55059 Some computational capabilities for nonlinear finite element analysis. Bathe, K.J.; Bolourchi, S.; Ramaswamy, S.; Snyder, M.D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). *Nucl. Eng. Des.;* **46**: No. 2, 429-455(Apr 1978).

From 4. international conference on structural mechanics in reactor technology; San Francisco, USA (5 - 19 Aug 1977).

The computational capabilities available in the current version of the computer program ADINA for stress analysis of structures and continua are described. The program can be employed effectively for various linear and nonlinear static and dynamic finite element analyses. The solutions of some problems using ADINA are presented to indicate the solution capabilities of the program.

55060 Inelasticity and the ASME code. Berman, I. (Foster Wheeler Corp., Livingston, N.J. (USA)). *Nucl. Eng. Des.;* **46**: No. 2, 335-348(Apr 1978).

From 4. international conference on structural mechanics in reactor technology; San Francisco, USA (5 - 19 Aug 1977).

Although it may have more general applicability, this paper is specifically concerned with some aspects of plasticity for class I nuclear components that are contained in section III of the ASME Boiler and Pressure Vessel Code. It directly addresses design for components at temperatures at which creep is not a factor. A review is made of the relationship of plasticity to each of the three failure modes that the stress limits are intended to prevent. It is found that the prevention of bursting and gross distortion from a single application of pressure and the prevention of fatigue failure caused by repeated cycles of peak stresses are well supported by experimental results. The experimental verification for the rules to show that the primary plus secondary stresses shakedown to elastic behavior is not clear. Various directed efforts which could lead to greater assurance of shakedown to elastic behavior are suggested. The major approach should be a massive program to develop a test matrix of experimental information for various portions of each component of interest in the Code.

55061 Finite element analysis of thin and thick-walled tubular joints. Gantayat, A.N.; Powell, G.H. (California Univ., Berkeley (USA)). *Nucl. Eng. Des.;* **46**: No. 2, 381-394(Apr 1978).

From 4. international conference on structural mechanics in reactor technology; San Francisco, USA (5 - 19 Aug 1977).

A finite element procedure and the associated computer programs for the analysis of thin and thick walled tubular tee joints used in nuclear power plant piping systems are described. A discussion of investigations of several basic problems is first presented, including characteristics of different types of relevant finite elements, and procedures for automated generation of finite element data. Next, descriptions of computer programs are presented for (i) stress analysis under arbitrary mechanical loadings; (ii) transient heat flow analysis for specified time and location dependent surface temperature changes, and (iii) thermal stress analysis for temperature distributions determined from heat flow analysis. Results of typical analyses are also presented. It is finally concluded that the developed computer programs are computationally efficient and easy to use for comprehensive analyses of tubular tee joints under different loading conditions.

55062 Metal containments: nature of loads and behavior limits. Skundric, L.I. *Nucl. Eng. Des.;* **46**: No. 2, 409-416(Apr 1978).

From 4. international conference on structural mechanics in reactor technology; San Francisco, USA (5 - 19 Aug 1977).

The subjects of loads, load combinations, and behavior limits of metal containments are discussed, with all such discussions fully recognizing the prime importance of containment system safety. The load probabilities associated with both individual loads and load categories are dealt with and are used as a basis for a rational evaluation of those stresses allowed under ASME Code Section III Division 1 and other applicable USNRC Regulatory Guides. In addition, the author presents some current observations on the design of local stress areas and the limits of buckling behavior.

55063 Terms of quality and delivery of welding filler metals used for welding austenitic chromium-nickel steels in nuclear power plant construction. Baumgart, D. (Zentralinstitut fuer Schweisstechnik, Halle (German Democratic Republic)). *ZIS (Zentralinst. Schweisstech.)-Mitt.;* **20**: No. 3, 288-292(Mar 1978). (In German).

Materials testing and quality control of welding filler metals (welding electrodes and wires) are briefly described. According to relevant standards producers have to check the following properties: chemical composition, tensile strength, notched-bar impact strenght, tensile yield point at elevated temperature, intercrystalline corrosion resistance, hot-cracking resistance, porosity resistance, and welding properties. If the results are satisfying the electrodes and wires obtain a quality mark, and their applicability in nuclear power plant construction is certified.

55064 Integral leakage rate tests of containments. Engel, M. (Technischer Ueberwachungs-Verein Bayern e.V., Muenchen (Germany, F.R.). Abt. fuer Materialpruefung und Umweltschutz); Siefart, E. (DIN Deutsches Inst. fuer Normung e.V., Berlin (Germany, F.R.). Fachnormenausschuss Kerntechnik); Walter, R. (Karlsruhe Univ. (TH) (Germany, F.R.). Inst. fuer Baustatik und Messtechnik). *Kerntechnik;* **20**: No. 3, 120-126(Mar 1978). (In German).

A method is presented for the integral leakage rate tests of containments. This method, used in conjunction with statistical methods, provides reliable information on the tightness of the containment. This method forms the basis of DIN 25436/KTA 3405.

55065 Built-in pipes and tubes under external pressure. Meincke, H. *Chem.-Ing.-Tech.;* **50**: No. 3, 215-217(Mar 1978). (In German).

As a result of serious damage to a bank of tubes and pipes or to individual tubes and pipes under external pressure, it is necessary to have safer rules for correct calculations and construction than has been the case so far. On the basis of new knowledge and on the basis of evaluations of tests and cases of damage, the article deals with a safe design of pipes and tubes under external pressure.

55066 Remote controlled ultrasonic pre-service and in-service inspections of reactor pressure vessels. Mueller, G. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A.G., Nuernberg (Germany, F.R.)). *Kerntechnik;* **20**: No. 3, 114-119(Mar 1978). (In German).

Remote-controlled ultrasonic pre-service and in-service inspections of reactor pressure vessels are part of a lot of security controls of nuclear power stations. The necessary equipment needed as manipulators, probe-systems, ultrasonic electronic and data recording and evaluating devices is explained in detail.

55067 Examination of pressure vessels for nuclear power plants. Trumpfheller, R. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.)). *Kerntechnik;* **20**: No. 3, 109-113(Mar 1978). (In German, English).

The Guidelines and supplementary specifications of the Reactor Safety Commission lay down particularly stringent requirements regarding the layout, design, selection of materials and safe fabrication methods for pressure vessels in nuclear power plants. Compliance with these requirements is ensured by comprehensive quality assurance specifications. The requisite properties of the pressure-carrying components are ensured by systematic checks of the layout and design, certification of the starting materials and of the welding materials, surveillance of fabrication and extensive examinations.

55068 Graph theoretical models for calculating the reliablility of power plants. Pt. 4. Availability of systems with deteriorating or non-deteriorating components. Vetterkind, D.W. *Tech. Ueberwach.;* **19**: No. 3, 91-97(Mar 1978). (In German).

With the aid of mathematical formalisms from the theory of stochastical networks, approximation equations are derived for the expectation value as well as for the scattering of period-related availability of series systems consisting of deteriorating and/or non-deteriorating components. In this context, successive operating times of deteriorating components are described by the time-dependent Poisson process while successive operating times of non-deteriorating components are described by the time-independent Poisson process. In addition provision is made in the model to include in the calculation an existing trend of the expectation value of components successive failure times.

55069 Hebezeuge in kerntechnischen Anlagen. Enwurf. (Lifting devices in nuclear facilities. Draft). Koeln, Germany, F.R.; Heymanns (1978). 4p. (In German). (KTA—3902).

Included are changes in paragraphs 4.2 and 8.1.3 of the regulation No. KTA-3902 dated 11/75.

55070 Possibilities and limits of the water pressure test in vessels and piping systems of nuclear power stations. Bergemann, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). *Energietechnik;* **27**: No. 11, 458-466(Nov 1977). (In German).

The water pressure test becomes unreliable if the interval between two tests amounts to 8 years. Taking into consideration fracture mechanics a geometrical test sequence is indicated. Facilities in which conditions deteriorate due to material embrittlement by neutron irradiation require an arithmetical test sequence. In both cases the high number of tests can be reduced by coupling the pressure test with acoustic emission analysis.

55071 Utilization of complexones in USSR's heat production. Margulova, T.Ch. *Energietechnik;* **27**: No. 11, 425-427(Nov 1977). (In German).

EDTA and disodium tetrine are intensively used for purification of steam generators of both fossil fueled and nuclear power stations in the USSR. The following topics are discussed in detail: boiler pickling, local pickling of cooling walls, utilization of the thermal decomposition of complexones, and microdosage of EDTA for continuous feed-water softening in steam generators.

55072 Pressure vessel for nuclear reactors. Kuenstle, K. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,033,179/B/. 29 Sep 1977. 3p. (In German).

A supplement is disclosed to patent P2032791.7 with the aim of simplifying the manufacture by using proper roll profiles allowing ot save weldings in fabricating a pressure vessel of a special type. The special pressure vessel protected by the base patent has smaller wall thicknesses and smaller thermal stresses due to a removal of some of the load with the aid of an internal supporting structure absorbing tensile forces. This supporting structure within the round or polygonal vessel cross-section consists of triangular, quadrangular, or hexagonal tubes being-pitted by and coaxially to the axis of vessel-welded close together into the vessel. The claims publication of the additional patent teaches that these tubes may be advantageously formed by warped sheets or roll profiles welded together with, e.g., Y- or double-Y-shaped cross-sections. For this purpose, the welding seams are laid in each case to (the middle of) the side walls of the prisms where they can easily and safely be produced automatically. For lack of differential pressures within the honeycomb structure, only small tensile stresses will occur which can be controlled by wall thicknesses of up to 10 mm. The monolayer welding sufficient for it allows simple X-ray inspection immediately after fabrication.

55073 Nuclear reactor pressure vessel. Biemueller, E.C. (to Combustion Engineering, Inc., Windsor, Conn. (USA)). German(FRG) Patent 2,709,906/A/. 15 Sep 1977. 7p. (In German).

The invention concerns a reactor pressure vessel made of steel pieces welded together and characterized by the welds having a composition which can only slightly be influenced by neutron irradiation and thus their values of tensile stress are reduced no faster than the wall material. According to the invention the ratio of the sums of w/o for Ni and Si on one hand and Mn, Cr, and Mo on the other shall be 0.4 or less in the alloy of the weld. Furthermore, the limits for the additions of C, P, S, Cu, and V in the Fe alloy are given.

55074 Vapors separator vessel in standing configuration for a nuclear reactor plant. Bubenzer, E. (to Steinmueller (L. u. C.) G.m.b.H., Gummersbach (Germany, F.R.)). German(FRG) Patent 2,401,644/B/. 15 Sep 1977. 3p. (In German).

By refinement of the basic patent P2256766.4 liquid droplets down to a size of 10^{-9} can be separated from radioactive vapors. This is achieved in a simple way by doubling the amount of separators and agglomerators. The upright standing cylindrical vapors separator vessel consists of a lower part with a feed line for the water-steam mixture, an outlet for the waste water enriched in radioactive particles, an inspection hole, a manhole, and an upper part with two identical separating groups arranged one above the other. The vapors fed to the lower part rise through a perforated bottom to the fast separating group, with the exception of a directly condensing portion collected as waste in the lower part. In the first separating group, the mixture passes in cross direction through a separator, an agglomerator, and a second separator; separated waste droplets are directly discharged to the waste water in the lower part. The steam already predried in this way flows through the upper separating group in the same sequence, beginning with a second perforated bottom. Dry steam relieved from radioactive impurities leaves the upper part at the upper end.

55075 Flame-sprayed furnace for reactor irradiation capsules. Sigismund, E. (Kernforschungsanlage Juelich G.m.b.H. (Germany,

F.R.). Zentralabteilung Allgemeine Technologie). *Schweissen Schneiden;* **29**: No. 9, 349-350(Sep 1977). (In German).

The construction and fabrication of furnaces for reactor irradiation equipment are described in which temperatures up to 850°C may be obtained by means of miniature heat conductors. In order to guarantee perfect thermal contact, the heat conductors had to be embedded in a flame-sprayed metal layer. The heaters thus fabricated were tested in fatigue tests (at 500 or 1,000°C) and for thermal shocks.

55076 Closing device for the temporary flow medium-tight closure of a chamber taking up the reactor vessel of a nuclear reactor. Taft, W.G. (to Westinghouse Electric Corp., East Pittsburgh, Pa. (USA)). German(FRG) Patent 1,904,463/B/. 11 Aug 1977. 4p. (In German).

The reactor pressure vessel in nuclear reactors is generally placed in a chamber which can be flowded for radiation shielding while the fuel elements are exchanged. The invention deals with a closing device to close off the chamber flow medium-tight, enabling a fast closing and opening. According to the invention, screw spindles are proposed for this purpose.

55077 Device for analyzing foreign substances contained in live steam. John, H. (to Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). German(FRG) Patent 1,943,669/C/. 28 Jul 1977. 4p. (In German).

This live steam sampling device for analyzing radioactive material contained in it avoids adulterations of the measuried results as may be caused by long live steam travels and dispenses with expensive high-pressure pumps for feeding back the condensate. The device essentially consists of a steam ejector combined with a heat exchanger. An 'external pipe' radially extends relatively far into the live steam pipe from which samples are to be taken. The lower part of the external pipe coaxially contains a cylindrical steam ejector whose diffuser outlet continues into an 'internal pipe'. An equal diameter of steam ejector and internal pipe leaves free, over the total length, a pipe-shaped annulus to the inner diameter of the external pipe. The sample steam extracted from the live steam space through a pipe bend flows through the steam ejector expanding into the adjoining internal pipe. The condensate flowing down through the pipe-shaped annulus is sucked in through the steam ejector and admixed again to the steam. By heat transfer to the condensate in counterflow the steam is cooled down to wet saturated steam and liquefied in a subsequent condenser. Part of the condensate flows from there to the analyzing device, another part is directly removed in parallel to it, and a third part is recycled via the annulus. The lower section of the external pipe including the diffuser is still contained within the live steam space of the steam pipe.

55078 Safety in cases of nuclear reactor pressure vessel rupture. Cerjak, H.; Heller, M.; Schabert, H.P. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,059,975/B/. 12 May 1977. 7p. (In German).

So as to prevent fracture fragments escaping in the case of a sudden rupture in the pressure vessel of a nuclear reactor, it is proposed that a pot—shaped protective containment vessel of great thickness should be arranged relatively closely around the pressure vessel. This protective containment should be made up of several layers whereby the inner layer is ideally surrounded with a multilayered metal sheet. This protective containment should also ensure that in a case of bursting, the reactor core remains intact and may be cooled.

55079 Nuclear power plant. Schabert, H.P.; Drossel, R. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,531,168/B/. 28 Apr 1977. 5p. (In German).

The patent proposes an improvement for the support of a main-steam or feed-water pipe of a nuclear reactor plant subject to thermal stresses and heat expansiones while passing through the annulus between the containment and a secondary shield enclosing it. A special supporting body is proposed.

55080 Magnetostrictive device for high-temperature sound and vibration measurement in nuclear power stations. Hans, R.; Podgorski, J. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.)). *Siemens Rev.;* **44**: No. 4, 171-175(Apr 1977).

The demands on the monitoring systems in nuclear power stations are increasing continuously, not only because of more stringent safety requirements but also for reasons of plant availability and thus economic efficiency. The noise and vibration measurements which therefore have to be taken make it necessary to provide measuring devices with a high degree of efficiency, adequate sensitivity, and resistance to high temperatures, radiation, and corrosion. Probes using the magnetostrictive effect, whereby a ferromagnetic core changes its length in a magnetic field - a phenomenon which has been known for approximately fifty years - fulfill all the conditions for application in nuclear power stations.

55081 Holding device for irradiation samples in irradiation channels of nuclear reactors. Scholz, M. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,038,425/B/. 24 Mar 1977. 3p. (In German).

A holding device for irradiation samples is described which can be used also in bent irradiation channels of nuclear reactors. It provides effective cooling by means of the component currents of the reactor coolant which are led through the irradiation channels. The patent claims pertain to the design of the element which takes up the samples.

55082 Heat exchanger. Hayden, O. (to UKAEA London Office). German(FRG) Patent 2,637,605/A/. 3 Mar 1977. 11p. (In German).

In order to fasten the tubes of a tube bundle inside a heat exchanger of the type used in nuclear reactors to the tube wall or tube plate, it is proposed to seal the tubes with the aid of pressure pipe couplings, thus avoiding welded joints.

55083 Nuclear reactor plant. Schabert, H.P.; Laurer, E. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,536,199/A/. 17 Feb 1977. 11p. (In German).

The invention is concerned with a quick-closing valve on the main-steam pipe of a nuclear reactor plant. The quick-closing valve serves as isolating valve and as safety valve permitting depressurization in case of an accident. For normal operation a tube-shaped gate valve is provided as valve disc, enclosing an auxiliary valve disc to be used in case of accidents and which is opened at increased pressure to provide a smaller flow cross-section. The design features are described in detail.

55084 Device for positioning ultrasonic probes and/or television cameras on the outer surface of reactor pressure vessels. Zipser, R.; Dose, G.F. (to Babcock - Brown Boveri Reaktor G.m.b.H., Mannheim (Germany, F.R.)). German(FRG) Patent 2,516,938/B/. 17 Feb 1977. 5p. (In German).

The device makes possible periodical in-service inspections of welding seams and material of a reactor pressure vessel without local human presence. A 'support ring' encloses the pressure vessel in a horizontal plane with free space. It is vertically moved up and down in the space between pressure vessel and thermal shield by means of tackles. At a control desk placed in a protected area its movement is controlled and its vertical position is indicated. A 'rotating track' with its own drive is rotating remote-controlled on the 'support ring'. By a combination of the vertical with the rotating movement, an ultrasonic probe placed removably on the 'rotating hack', or a television camera will be brought to any position on the cylindrical circumference of the pressure vessel. Special devices extend the radius of action, in upward direction for inspecting the welding seams of the coolant nozzles, and in downward direction for the inspection of welds on the hemispherical bottom of the pressure vessel or on the outlet pipe nozzle placed there. The device remains installed during reactor operation, but is moved down to the lower horizontal surface of the thermal shield. Parts which are sensible to radiation like probes or television cameras and special devices will then be removed respectively mounted before beginning an inspection compaign. This position may be reached by the lower access in the biological shield and through an opening in the horizontal surface of the thermal shield.

55085 Tubular heat exchanger with wound tube bundles. Albold, D. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,553,397/B/. 20 Jan 1977. 3p. (In German).

The heat exchanger proposed will be suitable for a steam generating plant, especially as condenser for exhaust steam or as feed heater. This can be achieved by two measures: The inlet and outlet for the first medium are arranged at the same side, thus connections are simplified and shortened. Two compartments are made out of one of the shell comportment of the horizontal, cylindrical boiler. They are fed with exhaust steam of various pressures. The boiler is crossed vertically by a helical tube bundle. The tube bundle ends up in a tube plate on both sides, with neigbouring water box. The first water box has an upwards directed inlet nozzle for the liquid medium. The second water box has no outlet. In the corresponding tube plate not only the tube bundle welded in there ends up but also a central tube of a larger diameter which runs backwards through the whole boiler and through the first tube plate and in the second water box it is axially run outwards. This outlet is placed near the corresponding inlet nozzle of the first water box. A third tube plate separates the boiler into two halves. This tube plate arranged in the centre of the boiler is penetrated by the tube bundle and the central tube. Each half has one inlet and one outlet nozzle inserted into the boiler wall, at the top or at the bottom. Thus steam can be fed in seperately at the top by means of two different pressures and condensates may be discharged at the bottom. The central tube plate is vertically penetrated by each tube of the bundle.

55086 Tube in-shell heat exchanger. Willby, O.H.C.R. (to UKAEA London Office). French Patent 2,321,676/A/. 19 Aug 1976. Priority date 20 Aug 1975, United Kingdom of Great Britain and Northern Ireland (UK). 7p. (In French).

A tube-in-shell heat exchanger is described. It comprises a bundle of heat exchange tubes extending within an elongate shell. The tubes pass through a tube sheet and are connected thereto by means comprising branch pipes and compression pipe couplings.

55087 Device for filling up air cleaning cells with adsorbent coal and its loading process. Parish, H.C.; Allard, M.D.; Petit, J.L.; Sfulgis, I.S. French Patent 2,309,268/A/. 27 Apr 1976. Priority date 28 Apr 1975, United States of America (USA). 43p. (In French).

This invention concerns improved appliances enabling granules to be compressed, evenly on the whole, in a hopper, filter or any other component to be filled with such granules. This criterion is particularly important in the case of air filters using granulated adsorbing coal for separating the radioactive substances in the air should an ccident occur in a nuclear power station.

55088 Coolant pipe penetrating a nuclear reactor vessel and spaced from the peripheral face of the penetration hole. Schoessow, E.E. (to Babcock and Wilcox Co., Barberton, Ohio (USA)). French Patent 2,309,018/A/. 16 Apr 1976. Priority date 21 Apr 1975, United States of America (USA). 8p. (In French).

This invention refers to containments under pressure and specifically to a leak tight passage for a nuclear reactor pressure vessel to pass feed pipes into the vessel. Under this invention, the thermal stresses arising between the wall of the vessel and the sealed inlet passage are much reduced by a novel design of the sealed passage. Further, this passage is designed so that all the associated structures comply with the specifications and so that the passage and its welds can be subjected to controls and non-destructive tests. Also, this sealed passage is such that the temperature of the nuclear wall is practically unaffected, in the part near the passage, by the temperature of the feed pipe, channeling the cold fluid which crosses the intake end.

55089 Reactor airlock with pressure compensating valves. Kuhn, R. (to Noell (G.) und Co., Wuerzburg (Germany, F.R.)). German(FRG) Patent 2,150,466/B/. 19 Feb 1976. 4p. (In German).

In order to be able to accelerate the opening of doors in a reactor airlock on pressure equalization and thus to reduce waiting times, it is proposed to provide at the walls of the airlocks release mechanisms to be operated hydraulically or mechanically.

FUEL ELEMENTS

55090 Nuclear fuel pellet design to minimize dimensional changes. Chubb, W. (to Westinghouse Electric Corp.). US Patent 4,094,738. 13 Jun 1978. Filed date 19 May 1976. 12p.

An improved nuclear fuel composition characterized as a mixture of the dioxide of uranium and plutonium with pores of specified sizes and volumes of each size is described. The volume of pores of each size are adjusted so that as each group of pores of each size is removed by the nuclear fission induced process of densification, the volume removed is balanced by the volume added by the nuclear fission induced process of solid state swelling. This fuel composition is dimensionally stable in-pile to high burnups because the rate of pore removal is matched to the rate of swelling.

55091 Spacer st4ructure. Masetti, W.R. (to General Atomic Co.). US Patent 4,090,918. 23 May 1978. Filed date 8 Oct 1976. 6p.

A spacer structure is described for maintaining a spaced relation between a plurality of generally parallel fuel rods within a housing in a nuclear reactor. The spacer structure is comprised of a grid pattern of ribs slotted to interlock with each other. The slots are arranged in such a way that when the ribs are welded to each other, the weld shrinkage is distributed uniformly in all directions to reduce or eliminate the amount of rework necessary in manufacturing the spacer structure.

55092 Mixing vane grid spacer. Patterson, J.F.; Galbraith, K.P. (to Exxon Research and Engineering Co.). US Patent 4,089,741. 16 May 1978. Filed date 11 Jun 1976. 6p.

An improved mixing vane grid spacer having enhanced flow mixing capability by virtue of mixing vanes being positioned at welded intersecting joints of the spacer wherein each mixing vane has an opening or window formed therein substantially directly over the welded joint to provide improved flow mixing capability is described. Some of the vanes are slotted, depending on their particular location in the spacers. The intersecting joints are welded by initially providing consumable tabs at and within each window, which are consumed during the welding of the spacer joints.

55093 Method of filling a fuel rod for a nuclear reactor with inert gas and closing it. Bokyo, E.; Campbell, J. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). German(FRG) Patent 1,806,599/B/. 17 Feb 1977. 5p. (In German).

The method allows pressurized filling with inert gas of thin-walled fuel cans after previous evacuation. The can charged with fuel is brought into a filling device connected to a pressure tank and a vacuum pump. The can is closed on the upper and lower end by seemingly equal welded caps. The upper cap, however, has a central though bore and an annular tee-slot in the covering surface. After putting on and screwing of a pressure resistant cover on the pressure chamber, this cover and the can are evacuated. Then the valve to the inert gas cylinder is opened until the desired filling pressure is reached in the device and in the can. Then a welding electrode passed through is moved downward coaxially to the can. Its conical point hits the still open bore of the upper cap of the can. The inner collar of the annular tee-slot mentioned above is melted off and closes the upper cap pressure-tight. The cap also prevents transfer of the welding heat into the can. Internal fuel rod pressures from 70 to 133 at have successfully been applied; evacuation goes down to 0.1 Torr.

55094 Method for making nuclear fuel rods. Ballard, A.S.; Cooper, R.G.; Davis, D.E. (to General Atomic Co., San Diego, Calif. (USA)). French Patent 2,314,562/B/. 8 Jun 1976. Priority date 10 Jun 1975, United States of America (USA). 10p. (In French).

A method of manufacturing a nuclear rod is described. It comprises only partially filling a mold cavity with nuclear fuel particles, closing the mold cavity and reducing the volume thereof such that the fuel particles substantially fill the mold cavity, injecting a fluid solidifiable binder into the particle-filled mold cavity to fill the interstices between the fuel particles. The volume of particle-filled mold cavity is reduced by applying pressure to the contents thereof via a movable portion of mold cavity, and solidifying binder in cavity to form a fuel rod.

CONTROL SYSTEMS

55095 Control rod drives for nuclear reactors. Nishimura, A. (to Hitachi, Ltd.). US Patent 4,092,213. 30 May 1978. Priority date 4 Apr 1975, Japan. 14p.

A control rod drive for a nuclear reactor which has an index tube coupling a control rod at one end and connecting a drive piston at the other end is adapted to vertically move the index tube by hydraulic pressure applied thereto. The index tube is formed with at least one helical groove on the outer surface and a plurality of recesses on the bottom surface of the helical groove. Collet fingers each having one end always urged against the index tube and the other end secured to a drive cylinder are provided for controlling the movement of the index tube. The collet fingers are able to engage with and disengage from the helical groove during rapid insertion of the control rod into a reactor core while able to slide in the helical groove during extraction of the control rod out of the core and to engage with the recess to prevent the movement of the control rod.

55096 Nuclear reactor installation. Schabert, H.P.; Laurer, E. (to Kraftwerk Union AG). US Patent 4,092,214. 30 May 1978. Priority date 13 Aug 1975, German, Federal Republic of (F.R. Germany). 6p.

A nuclear reactor installation has a containment shell, a steam generator disposed in the interior of the containment shell, a live steam line extending from the steam generator through the containment shell to the exterior thereof, a fast-acting valve having a main valve seat and a movable main valve plate opening and closing on the main valve seat connecting the live steam line to the steam generator, the main valve plate being closable on the main valve seat in a pressure-dependent operation upon the occurrence of a leak in the live steam line, the valve and the line having substantially equal maximum aperture cross sections, pressure-dependent operating means for opening the main valve plate on the main valve seat at a pressure exceeding the operating pressure of the live steam line, and means for limiting the opening by the main valve plate on the main valve seat to at most about half the maximum aperture cross section. The main valve plate includes a tubular slider and an auxiliary valve plate surrounded by the tubular slider, a fixed guide member mutually sealing the tubular slider and the auxiliary valve plate, an auxiliary valve seat for the auxiliary valve plate formed in the guide member, the auxiliary valve plate being openable on the auxiliary valve seat with increasing steam pressure to provide a smaller aperture cross section.

55097 Nuclear reactor. Aubert, G. (to Commissariat a l'Energie Atomique). US Patent 4,092,216. 30 May 1978. Priority date 14 Dec 1973, France. 6p.

A device for guiding control rods of the absorber-pin cluster type and placed above the reactor core comprises a rigid top plate applied against the reactor vessel and provided with openings joined

to long vertical tubes in which the control rod assembly is slidably mounted, an intermediate plate below coolant outlets for the sliding displacement of each absorber pin through corresponding apertures in said plate, and short connecting tubes which preferably provide a mechanical connection between the intermediate plate and a bottom plate and serve to guide the absorber pins, or alternatively short connecting tubes which guide the absorber pins and support members rigidly connected between the plates.

55098 Control rod ejection retardation assembly. Jabsen, F.S. (to Babcock and Wilcox Co.). US Patent 4,090,917. 23 May 1978. Filed date 26 Jul 1976. 6p.

A control rod ejection retardation assembly is mounted to a control rod assembly of a nuclear reactor to retard the ejection of the control rod only during an undesired ejection of the control rod while allowing normal control rod movement and "scramming" operation to be drag free and unretarded. The ejection retardation assembly includes a piston assembly mounted to the control rod and having an opening thereto controlled by a ball valve. The piston assembly seals are made loose fitting to flow sufficient fluid flow through the seals to provide unhindered normal control rod movement even with the ball valve sealing the piston assembly opening. During undesired speedy ejection of the control rod, the ball valve seals the opening to prevent fluid flow to the piston assembly retarding piston movement and thereby controlling control rod movement. During a "scram" condition the ball valve unseals the piston opening allowing fluid to easily flow into the piston assembly to prevent any retardation of piston and control rod movement.

55099 Wide range neutron detection system. Todt, W.H. Sr. (to Westinghouse Electric Corp.). US Patent 4,086,490. 25 Apr 1978. Filed date 7 Jul 1976. 4p.

A neutron detection system for reactor control is described which is operable over a wide range of neutron flux levels. The system includes a fission type ionization chamber neutron detector, means for gamma and alpha signal compensation, and means for operating the neutron detector in the pulse counting mode for low neutron flux levels, and in the direct current mode for high neutron flux levels.

55100 Reference Nuclear Powerplant control building design. Stakutis, A.P.; Schultz, B.G.; Bright, L.S. (Stone and Webster Engineering Corp., Boston). *Proc. Am. Power Conf.;* **39**: 156-164(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The specifications for a PWR type reactor control room and related electric cables and display consoles are presented.

55101 Human factors in nuclear power plant control room design. Pack, R.W. (Electric Power Research Inst., Palo Alto, CA). *Proc. Am. Power Conf.;* **39**: 173-179(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Human factors engineering is an interdisciplinary specialty concerned with influencing the design of equipment systems, facilities, and operation environments to promote safe, efficient, and reliable operator performance. The Electric Power Research Institute (EPRI) has undertaken three projects studying the application of human factors engineering principles to the development of nuclear power plant control rooms.

55102 Design approach to pressurized water reactor load-change flexibility. Howell, F.C.; Mueller, N.P.; Dzikowski, K.J. (Westinghouse Electric Corp., Pittsburgh). *Proc. Am. Power Conf.;* **39**: 224-231(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

To increase the control flexibility of a large PWR, Westinghouse specifically addresses load follow capability as a design requirement of the automatic power control system. The design features and major components of this automatic system are discussed.

ENVIRONMENTAL ASPECTS

55103 (NUREG—0449) **Final site environmental statement: Blue Hills Station, Unit Nos. 1 and 2. Related to the determination of the suitability of Site G for eventual construction. Docket Nos. 50-510 and 50-511.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1978. 262p. NTIS $10.75.

The site suitability analysis is based on the assumption that the Blue Hills Station will employ two pressurized water reactors to produce outputs of approximately 2814 MWt each. Two steam turbine generators will use the heat produced to provide approximately 957 MWe (gross) each. The exhaust steam will be cooled by four low-profile round mechanical-draft cooling towers. Assuming construction of a nuclear station at site G, a summary of environmental impacts and adverse effects is presented.

55104 Nuclear power and the environment. Clarke, R.H. (National Radiological Protection Board, Harwell (UK)); Macdonald, H.F.; Wheatley, B.M. *Energy Dig. (London) ;* **7**: No. 2, 8-12(Apr 1978).

Work is discussed which is contributing to the development of the planning, siting and safety philosophies underlying the operation of CEGB nuclear power stations. The subject is dealt with under the headings: evolution of radiological protection standards; safety of nuclear plants; emergency procedures at CEGB nuclear power stations; population effects and collective dose; and radioactive waste management.

55105 Nuclear energy risk - its assessment and its acceptance. Fischerhof, H. *Energiewirtsch. Tagesfragen;* **28**: No. 3, 127-128(Mar 1978). (In German).

A penetrating critical analysis of the 'nuclear controversy' as well as new ways to conquer it are necessary in order to master the continuous conflict of opinion. The author directs attention to the psychological moment in dealing with apposing sections of the population, something which is not given enough consideration in his opinion. At the same time he calls for promoting national political awareness.

55106 Einstellungen und Verhalten der Bevoelkerung gegenueber verschiedenen Energiegewinnungsarten. Materialien. (Attitudes to and behaviour of the population with regard to various types of energy production. Materials). Matthoefer, H. (Bundesministerium fuer Forschung und Technologie, Bonn-Bad Godesberg (Germany, F.R.)). Bonn, Germany, F.R.; Koellen Druck und Verl. (1977). vp. (In German).

Discussions on energy in the FRG has spread to wide sections of the population. The present investigation takes this into account. The title points out the changed situation: Nuclear power and nuclear power stations still have a special position, but can no longer be regarded separately from economic requirements and other types of energy production. A momentary attitude held by people can easily lead one astray in problems of this difficulty. The attitudes of the population can change greatly in a short period of time, as is shown in this investigation. In order to understand such changes and their causes, one must investigate deeper causes of action. This has been attempted here, by examining attitudes and behaviour regarding various types of energy production not only at one point, but over a whole year, and relating it to larger economic and social conditions. The three power station sites, where the investigation was carried out by fourfold questioning, show very different attitudes. It is concluded that history, and social and economic situation have a much greater influence on attitudes than general statistical population characteristics such as social group or age group.

55107 Kleines Handbuch fuer Atomkraftwerksgegner. Leitfaden fuer den Widerstand. (Pocket manual for nuclear power plant opponents. A guide for resistance). Muenchen, Germany, F.R.; Trikont-Verl. (1977). 220p. (In German).

Following the recent events at Wyhl and Brokdorf, this book wants to present the main aspects and arguments for criticism of the energy supply. The conception is based on the thesis that discussion and decision should not be left to so-called experts. Thus, the booklet wants to make the problems of nuclear power plant construction and operation accessible to all. It is intended for practical use by citizen initiatives, schools, and ecology groups.

RADIOACTIVE EFFLUENTS

55108 Symposium on operating experience of nuclear reactors and power plants. Invited talks and contributed papers. Bombay; Department of Atomic Energy (1977). vp. (CONF-770260—).

From Symposium on operating experience of nuclear reactors and power plants; Bombay, India (7 Feb 1977).

Papers presented were processed individually for the Energy Data Base. (HDR)

55109 Publication concerning the draft of a technical safety standard of the Kerntechnischer Ausschuss. Dated March 14, 1978. *Bundesanzeiger;* **30**: No. 51, 2(Mar 1978). (In German).

Included are the contents of the draft for monitoring stationary LWR and HTR reactors.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 55034, 55873, 55925

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 54736, 55002, 55134, 55135, 55136, 55137, 55138, 55139, 55140

55110 (HEDL-SA—1440) **Delayed neutron parameters for the FFTF.** Daughtry, J.W.; Dobbin, K.D. (Westinghouse Hanford Co., Richland, WA (USA)). 1978. Contract EY-76-C-14-2170. 13p. (CONF-780622—48). Dep. NTIS (US Sales Only), PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

Delayed neutron parameters have been calculated for the Fast Test Reactor (FTR) and for the FTR Engineering Mockup Critical (EMC) assembly, using the most recent available evaluations of delayed neutron data. Using ENDF/B Version 4 delayed neutron parameters, β/sub eff/ is about 4% larger than the previously accepted value and the inhour-to-percent $\Delta k/k$ conversion factor is about 4% smaller. For beginning-of-life conditions, ^{235}U, ^{240}Pu, and ^{241}Pu contribute less than 10% to the total β/sub eff/ for the FTR and EMC, and, therefore, uncertainties in their delayed neutron data are relatively unimportant. Kinetics parameters calculated with a two-dimensional model of the FTR are less than a percent different from those obtained with a three-dimensional calculation. Thus the less expensive two-dimensional calculations are adequate.

55111 (HEDL-SA—1453) **Three-dimensional inelastic analysis of a small liquid sodium valve.** Weiner, E.O. (Hanford Engineering Development Lab., Richland, WA (USA)). 1978. Contract EY-76-C-14-2170. 29p. (CONF-780609—10). Dep. NTIS, PC A03/MF A01.

From ASME/CSME pressure vessels and piping conference; Montreal, Canada (25 Jun 1978).

A three-dimensional inelastic analysis of a small liquid sodium valve for the Fast Flux Text Facility was conducted to assess ratcheting and creep damage at temperatures to 1200°F using the MARC-CDC finite element program. A single mesh of twenty-node solid elements, representing the Y-type cylinder intersection, is used for both the heat transfer and mechanical computer runs. Material behavior is governed by kinematic and creep strain hardening, and the loading consists of steady mechanical loads with cyclic fluid thermal transients. The resulting creep damage is significantly smaller than that of a corresponding axisymmetric analysis, and plastic strains are confined to a single region.

55112 (HEDL-SA—1458) **Planned natural circulation testing in the Fast Flux Test Facility.** Bouchey, G.D.; Additon, S.L.; Parziale, E.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1978. Contract EY-76-C-14-2170. 31p. (CONF-780622—51). Dep. NTIS, PC A03/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

The natural circulation testing of FFTF is planned during three distinct periods in the Plant Acceptance Testing Program: secondary loop testing; low power (<5%) testing in the primary and secondary loops; and, high power (greater than or equal to 5%) transient testing. Planned testing during each of these periods and some typical test predictions that have been completed to-date will be discussed in more detail below.

55113 **Neutron convertor at reactor RB.** Strugar, P.; Soticj, O.; Ninkovicj, M.; Pesicj, M. (Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia)). pp 3-10 of Proceedings of the 21. conference on electronics, telecommunications, automation and nuclear engineering. Vol. 4. Belgrade; ETAN (1977). (In Serbian)

From Conference on electronics, telecommunications, automation and nuclear engineering; Banja Luka, Yugoslavia (10 Jun 1977).

A neutron converter at Reactor RB in the "Boris Kidric" Institute of Nuclear Sciences - Vinca has been constructed. Preliminary measurements have been shown that the converted neutron spectrum is very similar to the fission neutron spectrum. For the same integral reactor power, the measured neutron radiation dose has been about ten times larger with the neutron converter. The neutron converter offers wide possibilities, as in investigations in reactor physics, where the fission neutron spectra have been required, as well as in the field of neutron dosimetry and biological irradiations.

55114 (ORNL-TM—4283) **ORNL TSF pipe chase neutron streaming experiment: Phase Two.** McGregor, B.J.; Clifford, C.E.; Muckenthaler, F.J.; Mynatt, F.R. (Oak Ridge National Lab., TN (USA)). Aug 1975. Contract W-7405-ENG-26. 51p. Dep. NTIS, PC A04/MF A01.

A second ORNL Tower Shielding Facility experiment has been performed and analyzed in the investigation of techniques for predicting the extent of neutron streaming through the sodium coolant pipes of the Fast Flux Test Facility (FFTF). Measurements of neutron intensities were made with Bonner ball detectors, and neutron spectra were measured with a Benjamin spectrometer. The analysis consisted of calculations of the Bonner ball and spectrometer responses with the two-dimensional discrete ordinates code DOT-III using 50-group and 14-group cross-section sets and assumptions of both isotropic and anisotropic boundary sources at the pipe-chase entrance. The Monte Carlo codes AMC and MORSE were used to correct the DOT calculations for three-dimensional geometric effects inherent in the experiment. For points inside the plenum, the calculated and experimental Bonner ball responses are in exceptionally good agreement; for points outside the plenum the calculated responses are approximately 20% higher than the experimental results. The calculated and measured neutron spectra agree at all three locations. It is concluded that the same calculational approach would accurately predict, or possibly slightly overpredict, the neutron flux levels that will exist in the heat exchanger vaults of the FFTF.

55115 (ORNL/TM—6463) **High Flux Isotope Reactor. Quarterly report, January, February, and March of 1978.** Corbett, B.L.; McCord, R.V.; Poteet, K.H. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 23p. Dep. NTIS, PC A02/MF A01.

Routine reactor operation with four end-of-cycle shutdowns, one scheduled mid-cycle shutdown, and one unscheduled shutdown resulted in an on-stream time of 83.3%. The outer control plates were changed, and the semiannual core component inspection was made.

55116 (TID—28569) **LOFT monthly progress report for April 1978.** (Idaho National Engineering Lab., Idaho Falls (USA)). May 1978. Contract EY-76-C-07-1570. 144p. Dep. NTIS, MF A01.

Portions of document are illegible.

Cost and budget data through April 1978 are presented together with data on LOFT operation and performance.

55117 **Calculations on a checkerboard pool core.** Alp, C. (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy). *Atomkernenergie;* **31**: No. 4, 242-244(1978).

A series of two-group calculations that has been made on various checkerboard pool core configurations is presented. The core loading essentially consists of alternating array of MTR-type standard fuel elements and graphite pieces. The method of reactor calculations was based on the simple flux synthesis assuming the separability of axial and radial fluxes. The principal advantages of this array over the normal pool design are larger core volume, two different leakage spectra, longer neutron generation time, lower thermal form factor and even comparable flux levels (both thermal and fast) for irradiations. The results of the reactor calculations are in excellent agreement with the initial checkerboard experiments; the accuracy of the calculated reactivities and thermal fluxes are within 0.5% and 5%, respectively.

55118 **Experimental determination of ksub(eff) variation of PURNIMA I fast reactor during insertion of core into reflector.** Job, P.K.; Srinivasan, M. (Bhabha Atomic Research Centre, Bombay (India). Neutron Physics Section). *Atomkernenergie;* **31**: No. 4, 245-248(1978).

PURNIMA I is a PuO_2 fuelled small hard spectrum fast reactor, with a 3.5 litre core, at Trombay. During start-up when the core is inserted into a stationary copper and steel reflector, the reactor configuration constitutes a coupled core-reflector geometry. The variation of ksub(eff) of this complex assembly was determined through a number of subcritical multiplication measurements. This paper discusses the details of these measurements and their analysis. The relationships between ksub(eff) and estimated number of fuel pins for criticality at intermediate core positions is also discussed.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

REFER ALSO TO CITATION(S) 55115

55119 (UNI—1002) **Hanford Production Reactor decommissioning study: 100-F Area disposition plant and activities definition.** Powers, E.W.; Wegener, E.A. (United Nuclear Industries, Inc., Richland, WA (USA)). 28 Apr 1978. Contract EY-76-C-06-1857. 98p. Dep. NTIS, PC A05/MF A01.

The report is the third in a series of preparatory documents necessary for accomplishing the ultimate demolition of the 100-F Plutonium Production Reactor and its related facilities. The Disposition Plan and Activities Definition is the key planning document since it is here that the first effort is made to describe the mode to be applied, the end product to be achieved, and the management system to be employed in carrying out the disposition project. The document also identifies the major tasks necessary to accomplish com-

plete dismantlement and demolition of the 100-F Area facilities, and proposed techniques for performing these activities and tasks. Although conceptual, these methods and procedures provide the basis for preparation of the major activity descriptions and detailed work procedure documents.

REACTOR SAFETY

55120 (BAW—10095A(Rev.1)) **CONTEMPT: computer program for predicting containment pressure-temperature response to a loss-of-coolant accident.** Hsii, Y.H. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Generation Div.). Apr 1978. 68p. Babcock and Wilcox, Lynchburg, VA.

The CONTEMPT code is used by Babcock and Wilcox for containment analysis following a postulated loss of coolant accident. An additional model is described which is used for the calculation of long term post reflood mass and energy releases to the containment that is used for the containment design basis LOCA calculations. These calculations maximize the rate of energy flow to the containment. The mass and energy data are given to the containment designer for use in calculating the containment building design pressure and temperature and in sizing containment heat removal equipment.

55121 (BNL-NUREG—24357) **BNL instrumentation research program.** Abuaf, N.; Zimmer, G.A.; Jones, O.C. Jr. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 23p. (CONF-780362—1). Dep. NTIS, PC A02/MF A01.

From Two-phase instrumentation review meeting; Troy, NY, USA (13 Mar 1978).

The objective of the BNL Light Water Reactor Development Program is to obtain measurements of the volumetric vapor generation rates in flashing steam-water flows under steady and transient conditions of interest in accident analysis. Instrumentation in support of this activity was developed and constructed to obtain both local and global measurements of the appropriate information, i.e., void fraction and phase velocities. The methods described include local instruments (optical and r-f probes) that provide local information and a global densitometer using γ attenuation techniques. A minicomputer based data acquisition and data analysis system was also developed including a block signal analysis system with the proper time and frequency domain data manipulation software. This presentation summarizes the current status of the work and the accomplishments.

55122 (BNL-NUREG—50759) **Thermo-fluid mechanics of volume-heated boiling pools.** Greene, G.A.; Jones, O.C. Jr.; Schwarz, C.E. (Brookhaven National Lab., Upton, NY (USA)). Dec 1977. Contract EY-76-C-02-0016. 12p. Dep. NTIS (US Sales Only), PC A02/MF A01.

A program to study the behavior of volume-heated boiling pools has been undertaken at BNL in order to provide meaningful estimates of heat transfer mechanisms in such systems. Emphasis has been placed on developing appropriate scaling parameters to allow results to be applied to prototypical, hypothetical accident conditions in an LMFBR. It has been determined that, within experimental accuracy, a boiling pool seems to exhibit behavior much like a single-phase natural convection system with a much extended laminar film regime to local Rayleigh numbers approximately 10^{13}.

55123 (BNL-NUREG—50764) **Appraisal of possible combustion hazards associated with a high-temperature gas-cooled reactor.** Palmer, H.B.; Sibulkin, M.; Strehlow, R.A.; Yang, C.H. (Brookhaven National Lab., Upton, NY (USA)). Mar 1978. Contract EY-76-C-02-0016. 153p. Dep. NTIS, PC A08/MF A01.

The report presents a study of combustion hazards that may be associated with the High Temperature Gas Cooled Reactor (HTGR) in the event of a primary coolant circuit depressurization followed by water or air ingress into the prestressed concrete reactor vessel (PCRV). Reactions between graphite and steam or air produce the combustible gases H_2 and/or CO. When these gases are mixed with air in the containment vessel (CV), flammable mixtures may be formed. Various modes of combustion including diffusion or premixed flames and possibly detonation may be exhibited by these mixtures. These combustion processes may create high over-pressure, pressure waves, and very hot gases within the CV and hence may threaten the structural integrity of the CV or damage the instrumentation and control system installations within it. Possible circumstances leading to these hazards and the physical characteristics related to them are delineated and studied in the report.

55124 (BNL-NUREG—50806) **Analysis of SORS: a computer program for analyzing fission product release from HTGR cores during transient temperature excursions.** Dickey, J.M. (Brookhaven National Lab., Upton, NY (USA)). Apr 1978. Contract EY-76-C-02-0016. 87p. Dep. NTIS, PC A05/MF A01.

The code SORS was written by General Atomic to calculate the release of fission products from the fuel into the primary coolant during a hypothetical uncontrolled transient temperature excursion. The code assumes that the graphite core remains structurally intact. The release from the fuel particles is calculated using a coarse time step for several sections of the core. For the non-volatile elements, the code calculates a diffusion rate and an evaporation rate in each section of the core. The expression used for the evaporation rate is found to be incompatible with the rest of the assumptions used in the calculation.

55125 (BNL-NUREG—50820) **Reactor safety research programs. Quarterly progress report, January 1—March 31, 1978.** Romano, A.J. (comp.). (Brookhaven National Lab., Upton, NY (USA)). Apr 1978. Contract EY-76-C-02-0016. 171p. Dep. NTIS, PC A09/MF A01.

Progress is summarized in the following areas: (1) gas reactor safety evaluation, (2) THOR code development, (3) foreign code review, (4) SSC code development, (5) LMFBR and LWR safety experiments, (6) fast reactor safety code validation, (7) stress corrosion cracking of PWR steam generator tubing, and (8) technical coordination of structural integrity.

55126 (CONF-780507—18) **Response surface techniques developed for probabilistic analysis of accident consequences.** Vaurio, J.K. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 15p. Dep. NTIS, PC A02/MF A01.

From Probabilistic analysis of nuclear reactor safety; Los Angeles, CA, USA (8 May 1978).

Response surface techniques have been developed for obtaining probability distributions of the consequences of postulated nuclear reactor accidents. The probabilistic response surface methodology reported includes new knot-point selection schemes and response surface functions, functional transformations of both parameters and consequence variables, smooth synthesis of regionwise response surfaces and the treatment of random conditions for conditional distributions. The computer code PROSA developed for implementing these techniques is independent of the deterministic accident analysis codes. It can also be used for direct simulation of general analytical functions. The significance, accuracy and other merits of these features are discussed and typical results are presented for illustration purposes.

55127 (EPRI-ER—768) **Tornado missile risk analysis: probability modeling, simulation methodology, and case studies. Final report.** Twisdale, L.A.; Dunn, W.L.; Chu, J. (Carolina Power and Light Co., Raleigh, NC (USA)). May 1978. 241p. Dep. NTIS, PC A11/MF A01.

Mathematical models of the contributing events to the tornado missile hazard at nuclear power plants have been developed in which the major sources of uncertainty have been considered in a probabilistic framework. These models have been structured into a sequential event formalism which permits the treatment of both single and multiple missile generation events. A simulation computer code utilizing these models has been developed to obtain estimates of tornado missile event likelihoods. Two case studies have been analyzed: a single unit plant using the current NRC set of missiles and a two unit arrangement using an expanded missile set. Preliminary results suggest that the likelihood of missile strike and that of subsequent plant damage may be acceptably small.

55128 (EPRI-NP—748) **Wind field and trajectory models for tornado-propelled objects. Final report 2.** Redmann, G.H.; Radbill, J.R.; Marte, J.E.; Dergarabedian, P.; Fendell, F.E. (Jet Propulsion Lab., Pasadena, CA (USA)). May 1978. 250p. Dep. NTIS, PC A11/MF A01.

The report contains the results of the second phase of a research program which has as its objective the development of a mathematical model to predict the trajectory of tornado-borne objects postulated to be in the vicinity of nuclear power plants. An improved tornado wind field model satisfies the no-slip ground boundary condition of fluid mechanics and includes the functional dependence of eddy viscosity with altitude. Sub-scale wind tunnel data are obtained for all of the missiles currently specified for nuclear plant design. Confirmatory full-scale data are obtained for a 12-inch pipe and automobile. The original six-degree-of-freedom trajectory model is modified to include the improved wind field and increased capability as to body shapes and inertial characteristics that can be handled. The improved trajectory model is used to calculate maximum credible speeds, which for all of the heavy missiles are considerably less than those currently specified for design. Equivalent coefficients for use in three-degree-of-freedom models are developed and the sensitivity of range and speed to various trajectory parameters for the 12-inch diameter pipe is examined.

55129 (EPRI-NP—798) **Water impact tests of rigid and flexible cylinders. Final report.** Souter, K.; Krachman, H. (Developmental

Sciences, Inc., City of Industry, CA (USA)). May 1978. 197p. Dep. NTIS, PC A09/MF A01.

A test program involving both rigid (thick-wall) and flexible (thin-wall) cylinders of two sizes was conducted as part of a study of the response of structures to water impact. The cylinders were driven vertically downward into a tank of water to provide a first order simulation of the pool swell impact of BWR pressure suppression system components that may occur following a hypothetical loss-of-coolant accident (LOCA). The models were instrumented to measure pressures, strains, accelerations, and forces. Although the models were simplified versions of their counterparts in a BWR and hence cannot be used to accurately predict the behavior of the more complex prototype, the tests provided extensive data that can be used to validate developing analytical techniques for calculating the complex phanomenon of hydrodynamically impacted structures. Comparisons of rigid and flexible cylinder data showed that flexibility reduces local impact pressures, but does not reduce the peak impact force (pressure integrated over the cylinder diameter). Also, agreement of data from the two model sizes supported the applicability of scaling laws to both elastic and inelastic behavior of structures under the water impact conditions examined in the test program.

55130 (EPRI-NP—801) **ATWS: a reappraisal. Part III. Frequency of anticipated transients. Interim report.** Leverenz, F.L. Jr.; Koren, J.M.; Erdmann, R.C.; Lellouche, G.S. (Science Applications, Inc., Palo Alto, CA (USA)). Jul 1978. 205p. Dep. NTIS, PC A10/MF A01.

The document is Part III of the Institute study of the ATWS question. The frequencies of the various events which have led to a reactor scram are documented from the nuclear power plant records. Some of these events, in the absence of scram, could lead to undesirable system response and are the "transients of significance" which comprise the anticipated transients of the ATWS question.

55131 (EPRI-NP—824) **Hydrodynamic impact analysis. Interim report.** Gross, M.B.; Geers, T.L.; Marcal, P.V.; Hirt, C.W.; Nichols, B.D. (Science Applications, Inc., Oakland, CA (USA); Lockheed Palo Alto Research Labs., CA (USA); MARC Analysis Research Corp., Palo Alto, CA (USA); Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 132p. Dep. NTIS, PC A07/MF A01.

The STEALTH computer code has been used to analyze the transient hydrodynamic impact of a long rigid cylinder on a large water pool. STEALTH is an explicit finite-difference computer program written in a Lagrangian formulation. The calculations reported here used the two-dimensional version of the code in a plane strain (translational symmetry) geometry. Important features of the calculations include a sophisticated capture logic which controls the impact and subsequent motion of mesh points which hit the cylinder, and a rezoning capability to limit mesh distortions. Impact velocities of 7.65 ft/sec and 24.2 ft/sec were considered. The results of these calculations compare closely with experimental data from pool impact tests performed by Developmental Sciences, Incorporated.

55132 (GEAP—23592) **BWR blowdown/emergency core cooling program preliminary facility description report for the BD/ECC1A test phase.** Letzring, W.J. (ed.). (General Electric Co., San Jose, CA (USA). Boiling Water Reactor Systems Dept.). Dec 1977. 198p. NTIS $6.00.

A two-loop test apparatus to be used in the BWR Blowdown/Emergency Core Cooling Program is described. The apparatus will be used for the investigation of reactor transient heat transfer featuring the operation of the core spray systems following the hypothetical recirculation line break (design basis accident). For physical scaling purposes, a typical boiling water reactor is modeled. Program background is outlined and program objectives are defined. Design basis is presented together with a detailed description of the test apparatus' operating performance. Measurement systems and data handling equipment are described in detail. Finally, performance predictions for the test apparatus are compared with boiling water reactor expected performance and with the design basis accident analysis performance.

55133 (GEFR—14023-5) **Risk analysis methods development. Fifth quarterly report, January—March 1978.** (General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.). Apr 1978. Contract EY-76-C-03-0893-032. 27p. AT.

The structure of two procedures for guiding R and D planning using the line-of-assurance (LOA) approach is presented. The first procedure (LOA Integration Procedure) identifies failure dependencies between the LOAs and evaluates their effect on the LOA success probability. The second procedure (Cost-Benefit Analysis Procedure) identifies the optimum R and D choice and ranks R and D options in terms of their expected net benefit. The relationship of these procedures to the R and D planning process is also presented. The LOA Integration Procedure takes as input individual LOA definitions (given in terms of the challenge envelope for which the LOA is designed), LOA success paths, and success probability and develops corresponding event trees with consideration of challenges beyond the challenge envelope. The resulting event trees are then linked for analysis of failure dependencies resulting from causes beyond the challenge envelope, random causes within the challenge envelope, and uncertainty in the predictive tools used for evaluating the LOA performance. Probability models for LOA failure with consideration of these dependencies are presented for the four LOAs. The Cost-Benefit Analysis Procedure defines R and D program options in terms of factors describing the R and D program success criterion, test design, and test facility characterization. The procedure confines itself to economic benefits only and leaves it to the decision-maker to compare various benefits based on his own non-economic values. Separation of economic and non-economic values was accomplished by designing the procedure to provide a ranking of test facility characterization options based on the R and D program and test design which gives the maximum expected net economic benefit. Procedures for defining the R and D success criterion and evaluating probability of the R and D program success are illustrated by examples. Cost and benefit functions are also described.

55134 (HEDL-SA—1459) **FFTF hot leg ruptures and loss of flow events.** Additon, S.L.; Chien, Y.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1978. Contract EY-76-C-14-2170. 52p. (CONF-780622—46). Dep. NTIS, PC A04/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

Two examples of recent FFTF design studies are discussed to illustrate the level of analytic complexity required to resolve design questions and the importance of system simulation. The first example is a study of postulated breaks in the primary hot leg piping. The second example is a study of the performance of the Plant Protection Systems during loss-of-flow events. Adequate safety margins were determined in both studies.

55135 (HEDL-TI—75001-26) **FSAR supplement 26: response to NRC Q_2 Set 11.** (Hanford Engineering Development Lab., Richland, WA (USA)). 9 Mar 1978. Contract EY-76-C-14-2170. 54p. AT.

Supplementary information is provided for incorporation in the FFTF Final Safety Analysis Report. (DG)

55136 (HEDL-TI—75001-27) **FSAR supplement 27: response to NRC Q_2 Set 12.** (Hanford Engineering Development Lab., Richland, WA (USA)). 9 Mar 1978. Contract EY-76-C-14-2170. 25p. AT.

Supplementary information is presented for incorporation in the FFTF Final Safety Analysis Report.

55137 (HEDL-TI—75001-28) **FSAR supplement 28: response to NRC Q_2 Set 13.** (Hanford Engineering Development Lab., Richland, WA (USA)). 9 Mar 1978. Contract EY-76-C-14-2170. 19p. AT.

Supplementary information is provided for incorporation in the FFTF Final Safety Analysis Report. (DG)

55138 (HEDL-TI—75002-23) **FSAR amendment 23: (change to chapter 17, as made by FSAR supplement 26).** (Hanford Engineering Development Lab., Richland, WA (USA)). 9 Mar 1978. Contract EY-76-C-14-2170. 13p. AT.

Supplementary information is provided for incorporation in the FFTF Final Safety Analysis Report. (DG)

55139 (HEDL-TI—75002-24) **FSAR amendment 24: addition to supplement 13, Q211.33, NRC Q_1, Set 8.** (Hanford Engineering Development Lab., Richland, WA (USA)). 9 Mar 1978. Contract EY-76-C-14-2170. 25p. AT.

Supplementary information is provided for incorporation in the FFTF Final Safety Analysis Report. (DG)

55140 (HEDL-TI—75002-25) **FSAR amendment 25: miscellaneous revisions.** (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1978. Contract EY-76-C-14-2170. 129p. AT.

Supplementary information is presented for incorporation in the FFTF Final Safety Analysis Report. (DG)

55141 **Aseismatic design and siting condition for nuclear reactors.** Ogino, K. (Kyoto Univ. (Japan). Faculty of Engineering). pp 355-440 of Genshiryoku hatsuden ni okeru anzenjo no shomondai. Osaka, Japan; Genshiryoku Joho Senta (1977). (In Japanese)

The history of aseismatic design in Japan, the geological structure of Japanese archipelago, the evaluation of the past earthquakes in Japan, the positions of seismic centers, the earthquakes directly under important installations, active faults, the earthquake waves being adopted in aseismatic design, maximum acceleration and prominent period, the history of the aseismatic design of Japanese nuclear power plants, the laws, regulations and standards for aseismatic design, and the aseismatic design and the siting problem in Ikata Nuclear Power Station as an example are described in detail.

The aseismatic design and the standard for the nuclear power plants in USA are also described for reference.

55142 (LA-UR—78-1335) **Numerical studies of multiphase flow in a pressurized water reactor.** Daly, B.J. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-26. 14p. Dep. NTIS, PC A02/MF A01.

The K-TIF numerical method for calculating the transient dynamics of two interpenetrating fluids has been extended and applied to the study of flow in a pressurized water reactor during a hypothetical loss of coolant accident. The method is verified by the comparison of results with small scale experiments. The extension to larger scale provides a tentative prediction of the appropriate inflow velocity scaling required to achieve flow similarity at all scales.

55143 (NEDE—24520) **Rigid and flexible vent header testing in the quarter scale test facility. Mark I Containment Program, Task 5.3.3.** Kennedy, W.; McGovern, D.; Maraschin, R.; Wolfe, K. (Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.). Mar 1978. 76p. General Electric Co., San Jose, CA.

Sixteen tests were conducted in the G.E. Quarter-scale Test Facility to study the effects of vent header flexibility on Mark I vent header impact loads caused by pool swell from a postulated loss of coolant accident. The first eight tests were conducted with a rigid vent header model; the remaining tests used a flexible model with ovalling stiffness approximately scaled for the Quarter-scale Facility. Both high- and low-impact conditions were studied. These conditions were produced by varying the drywell pressurization rate and the initial drywell-to-torus pressure difference (which controls the initial water level in the downcomers). Vent header loads were measured by a load cell and by eight flush-mounted pressure transducers distributed around the impact zone. The output from the pressure transducers provided details of the transient impact pressure distribution on the bottom quadrant of the vent header. Compared to the rigid vent header, the flexible vent header reduced the magnitude of the peak impact load and shifted the peak later in time. Local pressures generally were lower for the flexible cylinder.

55144 (NEDO—21472) **Analytical model for liquid jet properties for predicting forces on rigid submerged structures.** Moody, F.J.; Lasher, L.E.; Chow, L.C. (General Electric Co., San Jose, CA (USA). BWR Projects Dept.). Apr 1978. 29p. General Electric, San Jose, CA.

The unsteady discharge of a water jet into a suppression pool, caused by either a postulated loss-of-coolant accident (LOCA) or a safety relief valve (SRV) actuation, will create forces on structures in its path. This study provides a method for calculating submerged jet velocity and cross sectional area arriving at a given structure in terms of the jet discharge properties. Procedures are limited for use with ramshead, downcomer, or weir-vent type discharges.

55145 (NEDO—23703) **Single vent chugging model.** Healzer, J.M. (ed.). (General Electric Co., San Jose, CA (USA). Nuclear Energy Products Div.). Sep 1977. 79p. General Electric, San Jose, CA.

This report provides an analytical description of chugging, a phenomenon associated with low flow steam condensation. In addition to discussing the physical processes present in chugging, a model is presented which predicts the response of a single vent system to chugging. The model is used to predict the gross chug frequency (i.e., the time between chugs) as well as the detailed frequency content of the pressure history of an individual chug.

55146 (NEDO—24521) **Phase II investigation of the response of columns to short duration loadings: scaling report. Mark I Program, Task 3.2.1. Teledyne report TR-2488(e).** (Teledyne Engineering Services, Waltham, MA (USA)). Mar 1978. 56p. General Electric Co., San Jose, CA.

Phase II of a two-phase column testing program which will determine short-term load capacities for the Mark I containment columns is now under way. The scaling report is submitted to outline the scaling procedures and also to present the scaled quantities such as geometry, load eccentricity, and load time duration. Dimensional analysis and similarity techniques were applied to the experimental models to obtain a set of twelve scaling laws. These scaling laws provide a rational basis for modeling the columns. The scaling laws give nondimensional relationships which are common to both the model and prototype. Parameters which are known to be important in column buckling and which were found to be important during Phase I testing were used as the independent variables in the scaling laws. Column specimens for Phase II testing have been designed to be representative of the prototype columns. Combined bending and compression are characteristic of the Mark I columns with the maximum moment applied at the column-ring girder junction. The experimental columns reflect these characteristics, even though special fixtures and equipment will be required to perform the tests. The column specimens include the scaled rotational stiffness of the ring girder as well as the boundary condition of the pinned or sliding end. To properly incorporate the effects of residual stress, the models will be constructed from "off-the-shelf', carbon steel pipe and rolled sections, and built-up sections will be fabricated from standard plate. The column geometries scale almost exactly, even though "replica" modeling was not used.

55147 (NEDO—24522) **Mark I Containment Program structural acceptance criteria, containment system design rules, and classification.** (Teledyne Engineering Services, Waltham, MA (USA)). Apr 1978. 57p. General Electric Co., San Jose, CA.

Historical summaries of the development of the existing design rules are presented and the basis for selection of these rules are identified.

55148 (NP—23373) **Willingness-to-pay for decreased risk from nuclear plant accidents. Working Paper No. 43.** Mulligan, P.J. (Pennsylvania State Univ., University Park (USA). Center for the Study of Environmental Policy). Mar 1978. 77p. Pennsylvania State Univ., University Park.

The study examines one factor encompassed in the evaluation of the nuclear energy system: the collective value people assign to risk avoidance. The specific risks dealt with were the risks of death or injury due to nuclear plant accidents. This value figure was arrived at by having the study participants assign monetary values to changes in the probabilities of plant accidents. No attempt was made to establish "real" accident probability rates, rather, the issue was treated hypothetically. The method by which this value figure was approached was through a study examining willingness-to-pay for decreased risk, and conversely, willingness-to-be-compensated to permit risk increase.

55149 (NUREG/CR—0056) **Critical heat flux under transient conditions: a literature survey.** Leung, J.C.M. (Argonne National Lab., IL (USA)). Jun 1978. Contract W-31-109-ENG-38. 63p. (ANL—78-39). Dep. NTIS, PC A04/MF A01.

An extensive literature survey of transient critical heat flux (CHF) studies in forced convective boiling system is made. It includes both domestic and foreign works and covers three main types of transient: flow decay, power excursion and depressurization (blowdown) transients. The first part of the report surveys the transient CHF correlations and physical models and the second part summarizes experimental investigations. In the latter portion, much attention is given to the blowdown studies related to the loss-of-coolant accident in both light- and heavy-water reactors. The influence of various system parameters on time to CHF during the blowdown is summarized.

55150 (ORNL/NUREG/NSIC—128) **HTGR safety. 1. Review of current issues and bibliography of literature (1960—1977).** Buchanan, J.R.; Keilholtz, G.W. (Oak Ridge National Lab., TN (USA)). 21 Jun 1978. Contract W-7405-ENG-26. 122p. (NUREG/CR—0214). Dep. NTIS, PC A06/MF A01.

Portions of document are illegible.

The current status of the advanced high-temperature gas-cooled reactor (HTGR) technology and some conceptual information on the gas-cooled fast breeder reactor (GCFR) are presented in this report. Some data on operating experience are included for reactors in the United States, United Kingdom, Federal Republic of Germany, and France. Possible accidents are categorized and defined. Selected bibliographic information on all gas-cooled reactors relative to the development of the HTGR as a safe source of nuclear power is presented for the period 1960 through 1977, although information on the early British and French CO_2-cooled natural uranium reactors is excluded. The selected bibliography contains about 200 abstracts of the more significant reports covering early research and development and operating experiences leading up to the present design practices. Keyword, author, and permuted-title indexes are included for completeness.

55151 (ORNL/NUREG/TM—160) **Development of the capacitor discharge vaporization technique to produce aerosols formed under conditions postulated for hypothetical core disruptive accidents.** Kelly, M.J.; Parker, G.W.; Rochelle, J.M. (Oak Ridge National Lab., TN (USA)). 22 Jun 1978. Contract W-7405-ENG-26. 94p. (NUREG/CR—0226). Dep. NTIS, PC A05/MF A01.

This report describes the development of a Capacitor Discharge Vaporization (CDV) method for the out-of-pile creation of energy states in fast breeder reactor fuel (or simulants) that are consistent with those postulated for Hypothetical Core Disruptive Accidents (HCDA). The results of the development experiments, concurrent planning, test article construction, peripheral equipment design and construction, and computer modeling studies are discussed in relation to their effects on the design of the Oak Ridge National Laboratory's Capacitor Discharge Vaporization (ORNL CDV) System. The completed ORNL CDV System is described in detail, including all the required subsystems and data acquisition equipment. Operational features, equipment capability, and expected performance are also discussed.

55152 (SAND—78-0255C) **Effect of creep on thermal fracturing in oxide crusts.** Lipinski, R.J. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 7p. (CONF-780622—4). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

The stability of a fuel crust, especially on a molten sublayer such as steel, has been the subject of several papers. If the fuel crust is found to be unstable, the effect on a core-disruption accident could be far reaching: fuel would freeze more quickly in the structure above and below the core causing a plug and limiting the amount of early fuel dispersal, and high heat transfer to uninsulated walls, along with entrainment of cool steel droplets, would cool the fuel pool and reduce the amount of boilup. In a single subassembly accident, ablation of the walls would increase, thus increasing the amount of radial damage and the possibility of accident propagation. Conversely, a stable fuel crust would in general delay wall ablation and enhance upward fuel dispersal. It was recently proposed by Ostensen that a fuel crust would crack from thermal stress alone through as much as 75% of its thickness. In that paper, the effect of creep was left for future study. It is the purpose of this work to investigate that effect. A fuel crust growing on a layer of molten steel was considered.

55153 (SRD-R—99) **Definition of efficiency for fuel coolant interactions.** Vaughan, G.J.; Briscoe, F. (UKAEA Safety and Reliability Directorate, Culcheth). Feb 1978. 12p. Dep. NTIS (US Sales Only), PC A02/MF A01.

In the analysis of fuel coolant interactions, the efficiency of the conversion of the available energy in the initial configuration into mechanical work is often quoted. However, the method of calculation of this quantity employed by various authors is different giving rise to possible confusion when comparing different experiments. The authors review various methods of calculation and propose a standard definition of efficiency, which can be used in all situations, based on the maximum theoretical work calculated from the Hicks-Menzies model.

55154 (TID—28484) **RELAP5 hydrodynamic model. Progress summary: pilot code.** Ransom, V.H.; Trapp, J.A. (Idaho National Engineering Lab., Idaho Falls (USA)). Dec 1976. Contract EY-76-C-07-1570. 30p. Dep. NTIS, PC A03/MF A01.

The development progress on the RELAP5 two-velocity unequal temperature hydrodynamic model is summarized. In particular; calculational results are presented which have been obtained using a pilot code version of the two-velocity equal-temperature (2VET) model, development progress on the interface tracking scheme is summarized, and the development of the unequal temperature thermodynamic model is documented. The 2VET model is complete and undergoing developmental verification, the interface tracking model development has encountered numerical stability problems which are not yet resolved and the unequal temperature model development is underway. The unequal temperature model has been formulated, programmed into the pilot code, and is undergoing checkout and testing.

55155 (UCRL—80586) **Instrumenting a pressure suppression experiment for a Mark I boiling water reactor: another measurements engineering challenge.** Shay, W.M.; Brough, W.G.; Miller, T.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Apr 1978. Contract W-7405-ENG-48. 20p. (CONF-780565—3). Dep. NTIS, PC A02/MF A01.

From SESA spring meeting; Wichita, KS, USA (15 May 1978).

A $\frac{1}{9}$-scale test facility of a pressure-suppression system from a Mark I boiling water reactor was instrumented with seven types of transducers to obtain high-accuracy, dynamic loading data during a hypothetical loss-of-coolant accident. A total of 27 air tests have been completed with an average of 175 transducers recorded for each test. An end-to-end calibration of the total measurement system was run to establish accuracy of the data. The instrumentation verified the analysis of the dynamic loading of the pressure-suppression system.

55156 (WCAP—7907(Suppl.)) **LOFTRAN code description.** (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 26 May 1978. 131p. Westinghouse Electric Corp., Pittsburgh, PA.

The LOFTRAN code is a modular Library of Transient routines which simulate operation of a pressurized water reactor. To meet the need for increased analytical flexibility, the code has been expanded to model up to four independent reactor coolant loops, and a number of new models and user options have been incorporated. The code is now capable of analyzing events such as nonsymmetric steamline or feedline breaks, reactor coolant pump coastdown and startup, and transients in N-1 loop operation or with plugged steam generator tubes.

55157 (WCAP—9167) **Westinghouse Emergency Core Cooling System Evaluation Model for analyzing large LOCAS during operation with a loop out of service for plants without loop isolation valves.** Thompson, C.M.; Kelly, R.D.; Delsignore, T.A.; Muench, R.A.; Beczak, P.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Mar 1978. 98p. Westinghouse Electric Corp., Pittsburgh, PA.

This report describes the analytical Model and Computer Programs to be used for performing Appendix K ECCS analyses for a Loss-of-Coolant accident, which occurs during operation with a loop out of service (N-1 configuration) on a plant without Loop Isolation Valves (LISV) or for plants which are not utilizing their loop isolation valves. Results of analyses for a Westinghouse 4 loop (17 x 17 fueled) plant having a 14 foot core are presented along with appropriate sensitivity studies to verify and qualify the revised programs and models.

55158 (WCAP—9198) **Reactor vessel head drop analyses.** Alexander, D.W.; Shakely, R.; Dudek, D.F. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). 1978. 50p. Westinghouse Electric Corp., Pittsburgh, PA.

Various accident cases which involve dropping a reactor vessel head assembly in the refueling cavity were analyzed to determine the consequences. The analysis for each situation showed that the integrity of the fuel cladding and vessel nozzles and core cooling capability would be maintained.

55159 (WCAP—9223) **Westinghouse Emergency Core Cooling System small break, February 1978, evaluation model.** Skwarek, R.; Meyer, P.; Chismar, S. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). Feb 1978. 59p. Westinghouse Electric Corp., Pittsburgh, PA.

This report presents modifications to the small break calculations of the Westinghouse (W) Emergency Core Cooling Systems (ECCS) Evaluation Model. All changes described in this report make up the February, 1978 version of the ECCS small break evaluation model. It is recommended that these modifications be incorporated for all future ECCS design calculations.

55160 (WCAP—9289) **Integrated vessel head package for one-lift operation.** Leduc, R.J.; Alexander, D.W.; Dudek, D.F. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Mar 1978. 40p. Westinghouse Electric Corp, Pittsburgh, PA.

The Integrated Reactor Vessel Head Package and the postulated worst drop accident case are discussed within this report. The System description discusses the design bases and safety evaluation for the applicable components of the Integrated Reactor Vessel Head Package. The dropped Integrated Reactor Vessel Head Package analysis demonstrates that the integrity of the fuel cladding and vessel nozzles and the core cooling capability is maintained.

55161 **Mechanistic study of fuel freezing, channel plugging, and continued coolability during fast reactor overpower excursions.** Wong, K.W.; Dhir, V.K.; Kastenberg, W.E. (Univ. of California, Los Angeles). *Nucl. Technol.;* **39**: No. 2, 121-137(Jul 1978).

A mechanistic model that describes events leading to in-channel fuel plateout following fuel pin failure under slow transient overpower accident conditions has been proposed. The thermal and hydraulic effects of the plated out fuel have also been investigated. Results based on this model indicate that during a slow transient overpower accident (2.4 cent/s), in-core fuel freezing and channel plugging can be expected to occur. The extent of fuel freezing and channel plugging is sensitive to fuel particle size, the amount of fuel injected, and the amount of fission gas injected into the coolant channel. The results are also compared with experimental data from the TREAT H-4 experiment.

55162 **Development work for a borax internal core-catcher for a gas-cooled fast reactor.** Donne, M.D.; Dorner, S.; Schumacher, G. (Kernforschungszentrum, Karlsruhe, Ger.). *Nucl. Technol.;* **39**: No. 2, 138-154(Jul 1978).

Preliminary thermal calculations show that a corecatcher, which is able to cope with the complete meltdown of the core and blankets of a 1000-MW(electric) gas-cooled fast reactor, appears to be feasible. This core-catcher is based on borax ($Na_2B_4O_7$) dissolving the oxide fuel and the fission products occurring in oxide form. The borax is contained in steel boxes forming a 2.2-m-thick slab on the base of the reactor cavity inside the prestressed concrete reactor vessel (PCRV), just underneath the reactor core. After a complete meltdown accident, the fission products, in oxide form, are dispersed in the pool formed by the liquid borax. The metallic fission products are contained in the steel lying below the borax pool and in contact with the water-cooled PCRV liner. The volumetric power density of the molten core is conveniently reduced as it is dissolved in the borax, and the resulting heat fluxes at the borders of the pool can be safely carried away through the PCRV liner and its water cooling system.

55163 Hydraulic force calculation with hydro-structural interactions. Takeuchi, K. (Westinghouse Electric Corp., Pittsburgh). *Nucl. Technol.;* **39**: No. 2, 155-166(Jul 1978).

The computer code MULTIFLEX was developed to take into account hydro-structural interactions in the hydraulic force calculation for structural integrity evaluation of a pressurized water reactor primary system during a transient induced by a loss-of-coolant accident. Code verification was performed by analyzing the fundamental phenomena pertinent to the mutual interaction between the hydraulic and the structural systems. Phenomena investigated were the virtual mass effect of reducing the in-air structural frequency to the in-water frequency, the fluid compression effect due to structural deformation, and the effective sonic velocity for hydraulic pressure wave propagation. Experiments emphasizing each aspect of the phenomena were selected and analyzed. In the analyses, the independent mass model for the structural dynamics was exclusively employed. Satisfactory agreement between the analyses and the experimental data was obtained.

55164 Nuclear reactor plant. Schabert, H.P.; Drossel, R. (to Kraftwerk Union AG). US Patent 4,092,490. 30 May 1978. Priority date 11 Jul 1975, German, Federal Republic of (F.R. Germany). 6p.

A nuclear reactor plant has a containment shell, a secondary shield enclosing the containment shell and defining therewith an annular space therebetween and a double pipe of a live steam or feedwater line passing through the annular space and formed of a pair of inner and outer pipe portions defining an annular space therebetween. A support member supports an end of the double pipe in vicinity of the secondary shield, the support member having a substantially conical outer surface and being formed with an annular recess communicating with and terminating the annular space formed in the double pipe. Also provided are means for supporting the other end of the double pipe in the containment shell while affording longitudinal movement of the other end of the double pipe.

55165 Earthquake simulator studies of cylindrical tanks. Clough, D.P.; Clough, R.W. (California Univ., Davis (USA). Dept. of Civil Engineering). *Nucl. Eng. Des.;* **46**: No. 2, 367-380(Apr 1978).

From 4. international conference on structural mechanics in reactor technology; San Francisco, USA (5 - 19 Aug 1977).

An experimental investigation on the seismic response of ground-supported, cylindrical metal tanks is described. The actual seismic behavior of ground-supported tanks has not been known, and practical design methods necessarily have been based on simplifying assumptions. The present results provide the first opportunity for rational evaluation of seismic design assumptions, and suggest theoretical developments which would enhance the realism of refined seismic analyses. The aluminum scale model discussed here, 12 ft in diameter and 6 ft high, represents a 36-ft diameter steel prototype. It was tested, in anchored and unanchored base configurations, under action of a time-scaled El Centro, 1940, earthquake with peak acceleration of 0.5 g, using the Earthquake Simulator Faclity of the University of California, Berkeley. Stresses and displacements of the model, in both anchored and unanchored conditions, were dominated by effects of out-of-round response in higher-order circumferential modes, a result which is not predicted by current seismic analysis theory, and which contradicts basic assumptions of current design practice. The experimental observations are discussed in relation to dynamic analysis theory, practical design methods, and the history of tank performance in past earthquakes.

55166 Significance of warm prestress to crack initiation during thermal shock. Loss, F.J.; Gray, R.A.; Hawthorne, J.R. (Naval Research Lab., Washington, D.C. (USA)). *Nucl. Eng. Des.;* **46**: No. 2, 395-408(Apr 1978).

From 4. international conference on structural mechanics in reactor technology; San Francisco, USA (5 - 19 Aug 1977).

During a loss of coolant accident (LOCA) followed by operation of the emergency core cooling system, the inside wall of a nuclear pressure vessel is subjected to high thermal stresses that can cause extension of a pre-existing flaw. During this event the crack-tip stress intensity factor, Ksub(I) may achieve its maximum value early in the transient, but the critical level of crack initiation Ksub(Ic) may not be reached until minutes later at which time the loading has decreased from its peak. It is shown that this phenomenon, termed warm prestress (WPS), can preclude crack extension when Ksub(I) equals or exceeds Ksub(Ic).

55167 Soil-structure interaction analyses by finite elements - state of the art. Seed, H.B.; Lysmer, J. (California Univ., Davis (USA). Dept. of Civil Engineering). *Nucl. Eng. Des.;* **46**: No. 2, 349-365(Apr 1978).

From 4. international conference on structural mechanics in reactor technology; San Francisco, USA (5 - 19 Aug 1977).

In this paper the authors have attempted to summarize the current capability for evaluating soil-structure interaction effects during earthquakes using finite element procedures. A concise summary of methods available, together with their capabilities and relative costs is presented. It is suggested that finite element procedures provide a powerful tool for use in the design of nuclear plants, especially for embedded structures, and their applicability in this respect is illustrated by comparing computed results with those in a nuclear plant during a strong motion earthquake. It is concluded that when the methods are used in conjunction with good engineering judgment and with full recognition of their limitation, they provide evaluations of response with a level of accuracy entirely adequate for engineering design.

55168 Seismic analysis - what goal. Tagart, S.W. (Nuclear Services Corp., Campbell, Calif. (USA)). *Nucl. Eng. Des.;* **46**: No. 2, 417-427(Apr 1978).

From 4. international conference on structural mechanics in reactor technology; San Francisco, USA (5 - 19 Aug 1977).

The seismic analysis of nuclear components is characterized today by extensive engineering computer calculations in order to satisfy both the component standard codes such as ASME III as well as federal regulations and guides. The current nuclear siesmic design procedure has envolved in a fragmented fashion and continues to change its elements as improved technology leads to changing standards and guides. The dominant trend is a monotonic increase in the overall conservation with time causing a similar trend in costs of nuclear power plants. Ironically the improvements in the state of art are feeding a process which is eroding the very incentives that favored nuclear power in the first place. This paper examines the cause of this process and suggests that what is needed is a realistic goal which appropriately addresses the overall uncertainty of the seismic design process.

55169 Objectives of nuclear safety research. Westphal, H. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). *Atomwirtsch., Atomtech.;* **23**: No. 4, 189-191(Apr 1978). (In German).

From 5. Annual colloquium of the Projekt Nukleare Sicherheit of the Gesellschaft fuer Kernforschung m.b.H., Karlsruhe; Karlsruhe, Germany, F.R. (30 Nov - 1 Dec 1977).

The main objectives of nuclear safety research and development are the quantification of safety reserves in existing components and systems by means of safety experiments and analyses as well as the development of improved systems and safety equipment to prevent incidents and to reduce the risk of hypothetical accidents. About 80% of the nuclear safety research work sponsored by the Federal Government is concerned with an improved experimental and analytical investigation of very complex incidents and accidents in present reactor systems.

55170 Design of nuclear power plants in the Federal Republic of Germany as regards aircraft accidents. *Umwelt (Inf. Bundesminist. Innern);* No. 60, 26-28(Feb 1978). (In German).

On the basis of investigation results of aircraft crashes for the Federal territory and site assessment data of the Ministry of the Interior, air traffic does not present a notable hazard for a nuclear power plant. As a precautionary measure for reducing the remaining risk, design requirements for LWRs were developed which, independently of existing aircraft types, contain mainly an abstract predetermination of an idealized impact load - time diagramme.

55171 Hazards involved in industrial utilization of nuclear energy. Gauvenet, Andre (CEA, 75 - Paris (France)). *Def. Natl.;* 17-42(Nov 1977). (In French).

Radiation hazards induced by nuclear industry are presented: pollution caused by normal operation of the facilities, nuclear accidents, radioactive wastes, plutonium problems. Comparison with problems of the other energy sources is exposed.

55172 Guide to the safety design examination about light water reactor facilities for power generation. *Genshiryoku Shiryo;* No. 96, 1-20(Aug 1977). (In Japanese).

This guide was compiled to evaluate the validity of the design policy when the safety design is examined at the time of the application for approval of the installation of nuclear reactors. About 7 years has elapsed since the existing guide was established, and the more appropriate guide to evaluate the safety should be made on the basis of the knowledge and experience accumulated thereafter. The range of application of this guide is limited to the above described evaluation, and it is not intended as the general standard for the design of nuclear reactors. First, the definition of the words used in this guide is given. Then, the guide to the safety examination is described about the general matters of reactor facilities, nuclear reactors and the measuring and controlling system, reactor-stopping system, reactivity-controlling system and safety protection system, reactor-cooling system, reactor containment vessels, fuel handling and waste treatment system. Several matters which require attention in the application of this guide or the clarification of the significance and interpretation of the guide itself were found, therefore the explanation about them was added at the end of this guide.

55173 Agreements to ensure the safety of nuclear power plants. Meaning and contents. *At. Jpn.;* **21**: No. 8, 25-34(Aug 1977).

Agreements to guarantee the safety of nuclear power plants have been concluded between local goverments and electric power companies relating to the construction of nuclear power plants. The articles of the agreements are; (1) Observance of relevant laws and ordinances, (2) prior approval of plans for plant construction and expansion, (3) prior report, (4) reports during normal operations, (5) report in abnormal occurrences, (6) measurement of environmental radio activity, (7) survey of thermal effluents, (8) spot inspection, (9) compensation for damage, (10) management of radioactive wastes, (11) control on storage of radioactive waste, (12) safety guidance to companies responsible for the operation of nuclear power plants, (13) settlement of disputes and (14) reprocessing of spent fuel. These plant safety agreements have provided local governments with a means of getting the necessary information promptly from the power company. The local government, as the representative of the local people, has affirmed its right to participate in the safety administration of nuclear power plants. But the agreements are nevertheless little more than gentleman agreements, as the right of local governments to participate has not yet been legalized by the national government, and the agreements therefore have a number of problems that still have to be resolved. The counterplan for solution of these problems are discussed.

55174 Method and device for catching reactor core melt-down masses in hypothetical accidents of nuclear power plants. Morlock, G.; Wiesemes, J.; Bachner, D. German(FRG) Patent 2,556,558/A/. 30 Jun 1977. 5p. (In German).

The device is to receive the afterheat of the molten core and in this way to prevent afterflow of coolant and a new criticality. A tank below the reactor pressure vessel, with the proper diameter, contains a store of salt or a salt mixture suitable to receive the afterheat of a core melt-down as heat of fusion or conversion. Above the salt, there is a layer of thermoplastics or of a material forming a hardening foam. Coolant eventually continuing to flow out is separated from the core melt by this barrier layer, and thus the build-up of high steam pressures is prevented. Neutron-absorbing materials, like boron salts mixed to the salts, as well as a subdivision of the salt surface, e.g. by means of canalizing firebricks, prevent the formation of new criticality. Further installations within the tank, like pipings or channels, permit the introduction of water after cooling down of the core or salt melt-down mass and to wash out the brine with all radioactive and other constituents for transport to reprocessing or ultimate storage.

55175 Auxiliary process to safeguard the emergency cooling of a nuclear power plant. Bachl, H. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). German(FRG) Patent 2,342,263/B/. 10 Feb 1977. 3p. (In German).

It is suggested to use the auxiliary process of a nuclear power plant, which normally serves the security of self-supply of the reactor and which is designed as binary cold adsorption process, in case of failure of the main process to secure the emergency cooling. The invention is characterized in that in case of failure of the main heat process and use of emergency cooling with simultaneaous increase of the inlet temperature of the reactor coolant in the auxiliary process, the recycling of the poor solution is interupted, the whole binary mixture evaporated, and the saturated steam mixture is then superheated and pressure-released. The specific power of the auxiliary process thus increases considerably in a very short time, the energy given to the self-supply of the nuclear power plant is not interupted.

55176 Nuclear power plant with containment vessel for melting core mass. Katscher, W. (to Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). German(FRG) Patent 2,525,554/C/. 3 Feb 1977. 5p. (In German).

It is proposed that the cooling system for the containment vessel below the reactor core is to be improved, so that full cooling output is guaranteed, even in the most unfavourable conditions. According to the invention, heat pipes are to be set in the walls of the containment vessel, which may be connected in series. Ii is advantageous to connect the cooling pond filled with water to a large reservoir (e.g. fire extinguishing pond, natural lake). Further variations are described.

55177 Critical conditions during unsteady efflux of two-phase medium following the pipeline break. Rassokhin, N.G.; Kuzevanov, V.S.; Tsiklauri, G.V. (Moskovskij Ehnergeticheskij Inst. (USSR); AN SSSR, Moscow. Inst. Vysokikh Temperatur); Marinchek, Z. (Institut Jozef Stefan, Ljubljana (Yugoslavia)); Sella, Zh. (Centre Scientifique et Technique du Batiment, Centre d'Etudes Nucleaires de Grenoble, 38 (France)). *Teplofiz. Vys. Temp.;* **15**: No. 3, 589-597(1977). (In Russian).

Unsteady efflux of two-phase medium following the pipeline break has been studied. The experiments with saturated and underheated water at the pressure of 32 bar were carried out on the pipe with 102.3 mm diameter and 3 m length. The liquid underheating, reaching 14 deg C under the experimental conditions and parameter variation dynamics have been analyzed. A comparison with the quasi-stationary methods is given. The theoretical analysis of the unsteady efflux is made on the basis of the two-phase homogeneous equilibrium model. Numerical solution of the difference equations has been made along the characteristic directions by the Godynov layer method. The comparison of the calculated and experimental results gives a satisfactory agreement during the main unsealing period.

55178 Fire brigade organization and training at nuclear power plants. Currie, J.L. Washington, DC; Atomic Industrial Forum, Inc. (1977). 9p. (CONF-7705116—4).

From AIF's workshop on insurance; Atlanta, GA, USA (8 May 1977).

Management support necessary for the successful organization and training of a fire brigade is outlined. Brigade staffing is discussed and elements of the training program are outlined. The importance of a complete emergency plan is also discussed.

55179 New developments in loss control. Hathaway, L.R. Washington, DC; Atomic Industrial Forum, Inc. (1977). 20p. (CONF-7705116—9).

From AIF's workshop on insurance; Atlanta, GA, USA (8 May 1977).

Efforts at improving property-loss prevention standards at nuclear plants following the Browns Ferry fire are reviewed.

55180 Dynamic analysis using modal synthesis. Singh, A.K. New York; American Society of Civil Engineers (1977). 24p. (CONF-770448—8). American Society of Civil Engineers, 345 47th St., New York, NY.

From American Society of Civil Engineers spring convention; Dallas, TX, USA (25 Apr 1977).

The dynamic analysis of nuclear power plant structures and components accounts for a significant fraction of the total analysis effort. The dynamic effects may be due to seismic events, to fluid transients caused by valve closers or to pool dynamics caused by the safety release valve discharge. The dynamic analysis can be performed using the direct integration approach or by the modal superposition method. The modal method is preferred because (1) the mode shapes represent the nature of deformation of the structure thus facilitating the location of additional supports or stiffening requirements; (2) the method involves lesser computations than the direct integration method; and (3) the seismic excitation is generally prescribed by a response spectrum and dampings as a percentage of critical modal damping. In this paper a modal synthesis approach to compute the vibration modes of structural and piping systems is presented. Numerical results are presented to demonstrate the effects of the approximations on real structures and piping systems and rules are established for the minimum number of substructure modes which have to be considered to obtain accurate total structure mode shapes and frequencies.

55181 Studies on the dynamics of the subsoil according to the seismic uphole method. Luedeling, R. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)). *Geol. Jahrb., Reihe C;* No. 12, 3-82(1976). (In German).

In order to furnish the mathematical evidence of whether nuclear power plants are earthquake-proof, a shear modulus is required for the subsoil which corresponds to the load range of the design earthquake. This paper gives a description of an in-situ method for the determination of this value. The elastic properties of the subsoil are determined by means of the velocity of seismic waves and are transferred to the earthquake loading conditions according to the stress-strain characteristics the essential aspects of which are known.

55182 Materialien zum Unterrichtsversuch: Kernkraftwerke in der Einstellung von Jugendlichen. (Materials for the field test - students' attitudes to nuclear power stations). Hoffmann, L.; Kattmann, U.; Lucht, H.; Spada, H. (Kiel Univ. (Germany, F.R.). Inst. fuer die Paedagogik der Naturwissenschaften (IPN)). Kiel, Germany, F.R.; IPN (1975). 460p. (In German).

This working paper contains all the materials developed for and used in the field test of 'Student Attitudes toward Atomic Power Stations'. This research is a component of a larger project called 'Attitudes and Attitudes Change with Regard to Problems of Energy Supply and their Consequences for our Environment'. A central aim of this project is the development of instrumental strategies enabling the student to build up in this field a critically reflective and active behavior and attitudes based on sound problem consciousness. These instrumental strategies are derived from theories of social, learning and environmental psychology. A concrete result of these efforts are the materials of the field test mentioned above. They include: a) The draft of an instructional unit 'Atomic Power Stations - Prosperity or Disaster' with - a booklet on the subject matter for students and

teachers - a paper on the contents of the instructional unit and their sequence - information for the students concerning the aims of the investigation - working materials for the students - reading materials for the teachers informing them about the proposed instructional strategies based on the psychological theories: (1) model-learning and the structuring of knowledge, (2) how to activate and motivate students, (3) the stabilization of attitudes and (4) small group work. b) Instruments for testing and observation. These instruments were used within a criterion-oriented evaluation and for a test of the effects of the different proposed items used in the instruction.

ACCIDENT LIABILITY

REFER ALSO TO CITATION(S) 55217

ENERGY STORAGE

REFER ALSO TO CITATION(S) 54864

COMPRESSED GAS

55183 (CONF-780599—2) **Preliminary evaluation of the use of hydraulic air compressors in water-compensated reservoir compressed air storage power plants.** Ahrens, F.W.; Berghmans, J.A. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 23p. Dep. NTIS, PC A02/MF A01.

From CAES technology symposium; Pacific Grove, CA, USA (15 May 1978).

A new air compression system for CAES applications, based on the hydraulic compressor principle, is described and evaluated. In addition to yielding a more efficient use of energy from the base power plant, due to isothermal air compression, the hydraulic air compressor does not require the conventional intercoolers and aftercooler, and it replaces the air compressors with water pumps. Using performance characteristics predicted with an analytical model, a hydraulic compression system for a CAES plant is designed and compared with an equivalent conventional air compression system. The results indicate that the hydraulic air compressor-based CAES system would use less compression energy but would likely be more costly due to the number and size of the water shafts required.

55184 (CONF-780599—4) **Use of reciprocating engines in Compressed Air Energy Storage power plants.** Kartsounes, G.T.; Daley, J.G. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 36p. Dep. NTIS, PC A03/MF A01.

From CAES technology symposium; Pacific Grove, CA, USA (15 May 1978).

The application of reciprocating engines to compressed air energy is described. The expected advantages compared to conventional turbines and compressors are reduced reservoir size and cost, reduced equipment cost, reduced compression energy, increased overall plant efficiency, and increased energy storage effectiveness. The performance of possible engine and plant configurations are presented. One possible configuration is the use of a reversible expander/compressor engine; another is a hybrid reciprocating engine-turbomachinery concept. Capital and operating costs are also estimated and compared with that of conventional CAES plant designs.

55185 (CONF-780599—5) **Design of optimum aquifer reservoirs for CAES power plants.** Ahluwalia, R.K.; Sharma, A.; Ahrens, F.W. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 32p. Dep. NTIS, PC A03/MF A01.

From CAES technology symposium; Pacific Grove, CA, USA (15 May 1978).

The design of aquifer reservoirs for CAES applications involves the specification of a number of design variables and requires satisfaction of several constraints imposed by geological, aboveground machinery and utility load considerations. Because of the complexity, a significant potential exists for economic optimization. The paper sets forth a comprehensive framework for the design and optimization process which is based on a particularly advantageous decoupling of the CAES system; attention is focused on the aquifer reservoir, air distribution system and compression system. The state-of-the-art of the required technical information is discussed, and aspects needing further attention are noted.

55186 **Looking underground for energy storage.** Lowrey, J. *Engineer (London);* **246**: No. 6377, 50-51, 59(15 Jun 1978).

As an energy storage technology, the use of air, stored at pressure in underground caverns, seems a natural alternative to storing water at some elevated position. In both cases there is apparently "potential energy." The principle of compressed air storage is not new, but with the exception of the CEGB and the Massachusetts Institute of Technology, the adiabatic approach has been dismissed as impracticable or uneconomic. The heat given up in compression can be stored separately from the air in a regenerative heat store interposed between the turbomachinery and the air storage cavern. It may well be that commercial factors, rather than technical issues, will determine whether, and in what guise, compressed air storage eventually finds its way into the world's utilities.

PUMPED HYDRO

REFER ALSO TO CITATION(S) 55316

CAPACITOR BANKS

55187 (LA—7376-MS) **Newly discovered failure mode in high energy density, energy storage capacitors.** Boicourt, G.P.; Kemp, E.L. (Los Alamos Scientific Lab., NM (USA)). Jul 1978. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

High energy density pulse capacitors, typified by the 10-kV, 170-μF unit, have become widely used in recent years. These units primarily were designed for lower cost and higher energy per unit volume. The life characteristics of these units have never been determined fully, but they have already been shown capable of lives much longer than originally expected. The Los Alamos Scientific Laboratory is now conducting an extended program to determine the long-term capabilities of these capacitors. This program is aimed not only at finding the statistical parameters of the failure distribution but also at determining the physical failure modes characteristic of such units. Recently, a new failure mode was found. This failure mode has prevented test samples of polypropylene-paper-dioctyl phthalate units from actually reaching the true potential life of the insulation. In this report, the new failure mechanism is examined and suggestions are made that could eliminate the failure mode.

FLYWHEELS

55188 **Energy storing flywheel drive.** Kraus, C.E. (to Incelermatic, Inc.). US Patent 4,088,041. 9 May 1978. Filed date 13 Dec 1976. 6p.

An energy storing flywheel drive is described. The device includes two flywheels rotatably supported in a housing for rotation about a common axis and operatively connected to a common shaft through two planetary type traction roller transmissions. The first flywheel is connected to the sun member and the input-output shaft is associated with the planetary members of the first planetary transmission while its outer ring member is mounted in the housing and the second flywheel is connected to the sun member and the input-output shaft is connected to the outer ring member of the second planetary transmission while its planetary members are mounted on the housing thereby to cause, upon rotation of the input-output shaft, rotation of the flywheels in opposite directions. The transmission ratios of the planetary transmissions are selected so as to prevent the generation of gyroscopic forces.

THERMAL

REFER ALSO TO CITATION(S) 54843, 54863, 54936

55189 (COO—4009-1) **Rock bed heat accumulators. Final report.** Riaz, M. (Minnesota Univ., Minneapolis (USA)). Dec 1977. Contract EY-76-S-02-4009. 244p. Dep. NTIS, PC A11/MF A01.

The principal objectives of the research program on rock bed heat accumulators (or RBHA) are: (1) to investigate the technical and economic feasibility of storing large amounts of thermal energy (in the tens of MWt range) at high temperature (up to 500°C) over extended periods of time (up to 6 months) using native earth or rock materials; (2) to conduct studies to establish the performance characteristics of large rock bed heat accumulators at various power and temperature levels compatible with thermal conversion systems; and (3) to assess the materials and environmental problems associated with the operation of such large heat accumulators. Results of the study indicate that rock bed heat accumulators for seasonal storage are both technically and economically feasible, and hence could be exploited in various applications in which storage plays an essential role such as solar power and total energy systems, district and cogeneration heating systems.

55190 (TID—28330) **Thermal energy storage by means of saturated aqueous solutions. Final report, July 1976—November 1977.**

Kauffman, K.W.; Lorsch, H.G.; Kyllonen, D.M. (Franklin Inst. Research Labs., Philadelphia, PA (USA)). Nov 1977. Contract EY-76-C-05-5158. 102p. Dep. NTIS, PC A06/MF A01.

Results are presented of an investigation of the technical and economic feasibility of thermal energy storage devices employing the latent heat of crystallization of solutes in saturated aqueous solutions. Nine inorganic and two organic solutes were identified and characterized for residential off-peak electric and solar air conditioning and space heating. Solutes discussed included sodium carbonate, sodium sulfate, trisodium phosphate, boric acid, trimethylamine, and pinacol. Storage systems using these media offer lower heat transfer related costs than for storage in (constant temperature) phase change media and smaller storage volumes than for storage in water. An oil was successfully employed to transfer heat from a 0.11 m^3 (30 gallon) storage test device using sodium carbonate solution with no heat exchanger fouling and with good efficiency. Failure to achieve equilibrium solubility on warming was identified as a source of decreases in various measures of storage efficiency for the device using sodium carbonate. By using a medium, such as trimethylamine clathrate hydrate, which melts at a temperature useful for air conditioning, most of this penalty can be avoided.

55191 Fireplace heater. Johnson, J. US Patent 4,088,114. 9 May 1978. Filed date 12 Aug 1976. 8p.

The heat of a fireplace is absorbed by the device and conducted to a desired area or place instead of merely dissipating and escaping up through the chimney. The fireplace heater is comprised of an air conductor having a heat absorbing portion and an air passage through the air conductor and air moving means for moving air through the air passage of the air conductor thereby causing ambient air to pass through the heat absorbing portion which greatly increases the temperature of the air resulting in hot air coming out of the exit opening of the air conductor. An air hole in the air conductor faces in the direction of the fire and the size of the air hole is controlled by a valve. Since air is being moved through the air conductor by the air moving means the effect of the air hole is to fan the fire and give the fire additional oxygen resulting in a hotter fire and a much more easily started fire. The device is adaptable to various accessories so that various items can be heated or dried such as food, liquids or clothes.

BATTERIES

REFER ALSO TO CITATION(S) 55378, 55393

DESIGN AND DEVELOPMENT

55192 Automobile manufacturer's overview of the battery market. Caserio, M.J. (General Motors Corp., Warren, MI). *Yuasa Jiho;* No. 45, 1-13(Dec 1977).

General Motors' overview of the battery market is discussed in relation to energy, environment, product safety, and customer value. More fuel-efficient cars can be produced by reducing weight; battery weight has been reduced by use of wrought Pb—Ca alloys and new separator materials, both of which are lighter in weight. To reduce the use of natural gas in drying plates for dry-charge batteries, a new wet replacement battery was developed (Pb—Ca made this possible). Furnace heat is recovered and used for other purposes. Reduction of automobile emissions has resulted in higher under-hood temperatures, which are inimical to batteries; maintenance-free batteries can be located in other places. Special plants for liquid waste treatment have been built at battery factories. Battery explosions have been reduced by use of flame arrestors. Likely future trends include even lighter batteries, larger batteries for use in Diesel vehicles, and development of electric vehicles with improved lead—acid and later Ni/Zn battery packs. 29 figures. (RWR)

55193 New design for the high-performance sodium—sulfur battery. Kimura, S.; Iwabuchi, S.; Nakabayashi, T. *Yuasa Jiho;* No. 45, 57-64(Dec 1977). (In Japanese).

A new design for the sodium—sulfur battery employing a new cell construction is described. It includes a new method to join the solid electrolyte tube with the sodium reservoir made of metal, and an improved composition of the cell case to solve the problems of premature cell destruction and capacity decrease associated with the conventional design. As a result, a higher and more stable performance of the new design than that of the conventional design was shown through various evaluation tests. 11 figures, 7 tables.

55194 Review on maintenance-free automotive batteries with emphasis on the trend in the United States. Hattori, S. *Yuasa Jiho;* No. 44, 1-6(Apr 1977). (In Japanese).

Information on maintenance-free automotive batteries, especially in the United States is summarized; and the direction in which the maintenance-free automotive batteries are heading is reviewed. It is forecasted that by 1980 to 1981 a considerable amount of the automotive batteries in the United States will be maintenance free. 4 figures, 2 tables.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 55202

55195 Power box with built-in sealed lead—acid batteries. Tomokuni, Y.; Kimoto, E.; Horie, S. *Yuasa Jiho;* No. 45, 41-56(Dec 1977). (In Japanese).

A power box with built-in sealed lead—acid batteries was developed as an uninterruptible power supply system for terminal devices of various centrally controlled information systems. This power box is a maintenance-free, reliable power supply system specially designed for this kind of application. Employment of this power box ensures uninterrupted operation of the information systems regardless of commercial power failure, and will increase the reliability of the total systems. 21 figures, 2 tables.

55196 Field test results on Yumicron batteries (models Y110-5 and N50-Y1). Tambo, Y.; Kitagawa, K. *Yuasa Jiho;* No. 44, 7-15(Apr 1977). (In Japanese).

Yumicron batteries, models Y110-5 and N50-Y1, were put into the taxi field test in Sapporo (cold climate) and Odawara (mild climate) to compare their durability with that of the conventional model N50. The total driving distance reached 270,000 km for model Y110-5 and 200,000 km for model N50-Y1, greatly exceeding that for the conventional ones. The result revealed both the superiority of Yumicron batteries and the durability of the extraordinary thin Yumicron separator. 26 figures, 6 tables.

MATERIALS, COMPONENTS, AND AUXILIARIES

55197 Rechargeable accumulator having a manganese dioxide electrode and an acid electrolyte. Wurmb, R.; Beck, F.; Wunsch, G.; Boehlke, K.; Treptow, W. (to BASF AG). US Patent 4,096,318. 20 Jun 1978. Filed date 14 Apr 1977. 6p.

An accumulator has an acid electrolyte and possesses two electrodes of the first kind mounted on base electrodes. The active material on the positive side contains manganese dioxide. The base electrode on the negative side consists of powdered graphite embedded in a binder which is resistant to the electrolyte. The base electrode on the positive side has a coarse porous structure and consists of graphite or titanium coated with titanium nitride or titanium carbide. The average pore diameters are from 0.1 to 2 mm, and the pore volume is from 20 to 70%. 3 tables.

55198 Development of a quick charging system. *Yuasa Jiho;* No. 45, 14-22(Dec 1977). (In Japanese).

One of the major drawbacks of the electric vehicle is its relatively short driving range on one charge of its propulsion battery. In order to eliminate the inconvenience associated with this drawback in using elecric vehicles, a quick charging system was developed under a joint research program of the Yuasa Battery Company and the Daihatsu Motor Company. This is a system to recharge a partially discharged battery up to an 80% charged state within 30 minutes. Through extensive tests both in the laboratory as well as in the field, it was proved that this system is useful for extending the daily driving distance of the electric vehicle by giving a quick boosting charge during lunch time combined with slow complete charge to be given during nighttime without adverse effect to the battery life.

55199 New development in thin separators (Yumicron embossed waffle shape separator). Murata, K.; Shimada, T.; Sasaki, M. *Yuasa Jiho;* No. 45, 23-32(Dec 1977). (In Japanese).

The advantageous features of the Yumicron embossed waffle shape separator, developed to provide an ideal thin separator system for automotive batteries, are described. One of the features of the Yumicron embossed waffle shape separator is its unique structure. Retaining perfectly the features of being as thin as 0.1 to 0.2 mm as a microporous sheet, it offers the elasticity and anti-oxidation properties comparable to those of the separator with a glass fiber mat, the easy escape of evolving gas comparable to that of the corrugated separator, and better diffusion and convection of electrolyte because of its unique structure. This separator also has a property suitable to an enveloping material, and thus can be handled as a paper-like wrapping sheet. It is expected that this separator will play an everlasting role in maintenance-free automotive batteries and compact high-performance batteries to meet the demand for reliability and energy conservation. 23 figures, 6 tables.

55200 Development of catalyst plugs for automotive batteries. Ueda, K.; Nakao, S.; Masago, H. *Yuasa Jiho;* No. 45, 33-40(Dec 1977). (In Japanese).

With an aim to make automotive batteries (especially batteries for large vehicles) maintenance-free, two types of catalyst plugs were developed. They are composed of a combination of a catalyst

and a catalyst poison absorber (type A), or of only an improved catalyst shaped into pellets (type B), and their performance for automotive use was tested. As a result, it was found that both types of catalyst plugs can be put into practical use from the standpoint of both gas-recombination performance and safety, and furthermore that the type A shows an excellent catalyst poison-proof property, while the type B shows a superior gas-recombination performance under charging with a very small amount of current at low temperature. These catalyst plugs can easily be mounted on conventional automotive batteries and are superior in safety; therefore, they are expected to contribute to labor saving in the maintenance of automotive batteries. 15 figures, 3 tables.

55201 New lithium orthosilicate compounds and their application as solid electrolytes. Shannon, R.D.; Taylor, B.E. (to Du Pont de Nemours (E.I.) and Co.). German(FRG) Patent 2,702,080/A/. 28 Jul 1977. 33p. (In German).

Monoclinic solid electrolytes are synthesized according to the formula Li/sub 4+w-x-2y/Si/sub 1-w-x-y/Al/sub w/P/sub x/S / sub y/O, with w <= approximately 0.45, x <= approximately 0.5, and y <= approximately 0.35. A Li/sub 3.75/Si/sub 0.75/P /sub 0.25/O_4 has been synthesized in this manner and has been used as an electrolyte in a Li-Li_3MoV_{12} O_{34} battery. The terminal voltage of the battery was about 3.6 to 3.7 V in the temperature range between 100 and 225°C.

55202 Studies on anodic peeling of lead—antimony alloys. Okada, K.; Sahashi, H.; Miyanari, N.; Fujii, K. *Yuasa Jiho;* No. 44, 16-31(Apr 1977). (In Japanese).

Peeling which takes place on the positive poles and straps of lead—acid batteries under the charging condition encountered in the so-called floating use are studied. The peeling usually seems to occur in a form of a pine cone or a film. Poles made of lead—antimony (4%) alloy were corroded anodically under various conditions, and their weight loss, appearance of sediment and sectional view of corrosion products, etc., were examined with appropriate means including an electron microscope. As a result, sediment of fine particles was found to develop under a condition of continuous charge, while sediment due to peeling was found to increase with intermittent charge having rest periods between each charge period. From this, it was concluded that the most important factor which affects the growth of peeling is the rest periods during charging time. Other factors such as temperature and current density were also found to be likely to affect the progress of peeling. 21 figures, 6 tables.

55203 Analysis of shedding of active material in positive electrodes of lead—acid batteries. III. Influence of electrolyte concentration. Kohno, M.; Yamane, M.; Nakashima, H. *Yuasa Jiho;* No. 44, 32-40(Apr 1977). (In Japanese).

This research was conducted with an objective of clarifying the mechanism of active material softening and shedding in positive electrodes of lead—acid batteries with use of stronger acid. Although stronger acid surely accelerated the softening and shedding it was obvious that its mechanism is a little different from that in normal sp gr H_2SO_4, from considering the results of various measurements of the physical properties of the active material. Particularly, the DTA-TG measurement showed that the cells with stronger acid reached the end of life without showing structural change of active material. Furthermore, in stronger acid, there were observed a few examples showing the fact that crystals of PbO_2 are smaller than those in normal concentration electrolyte or contact state between PbO_2 crystals is worse than that in normal concentration electrolyte. For example in this respect, the broad half-value-width of the β-PbO_2 x-ray pattern, large specific surface area of active material before discharge, existence of smaller particles in the particle size distribution of PbO_2, and large resistivity of active material as it exists in electrodes are pointed out. Moreover, it was also shown that one of causes for a lower capacity in stronger acid is that crystals of $PbSO_4$ are smaller than those in normal concentration electrolyte. 19 figures, 4 tables.

APPLICATIONS

REFER ALSO TO CITATION(S) 54835, 55422, 55423, 55424, 55425, 55426, 55427, 55428, 55429, 55430, 55431, 55432, 55435, 55436, 55437, 55438

55204 Static uninterruptible power supply systems for electronic computers. Imakoma, H.; Yoshida, Y.; Sakamura, Y.; Iemura, H.; Miyake, M. *Yuasa Jiho;* No. 44, 56-68(Apr 1977). (In Japanese).

The development of static Uninterruptible Power Supply (UPS) systems is remarkable today and their capacities are quite large. UPS systems are required to have higher reliability and performance. The authors recently developed and practically produced a new UPS system for a large computer. It consists of a subsystem of 400 kVA and two subsystems of 150 kVA. This article describes an outline of the UPS system with stress on the inverter protection methods against commutation failures as well as on the oscillators suited for the constant-voltage constant-frequency (CVCF) inverters in parallel operation. 21 figures, 3 tables.

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 56309

55205 (CONF-780201—, pp 65-74) **Role of energy management in meeting energy needs in the Tennessee Valley region.** Snyder, W.T. (Univ. of Tennessee, Knoxville). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

The traditional definition of resources to be managed in performing an economically desirable industrial function includes land, labor, capital, and raw materials. To this classical list must now be added energy as a resource co-equal. Aspects of energy management not included in the definition of energy conservation are availability and cost of energy forms, substitution of energy forms, energy demand, developing procedures and methodologies for analyzing and monitoring energy consumption, and developing a contingency plan to cope with energy curtailments. Therefore, elements of energy management discussed, recognizing energy as a co-equal resource to be managed, are commitment of management; assignment of program responsibility; establishment of a reliable information data base; conducting an energy audit; identification and analysis of potential energy conservation opportunities (ECO); establishing goals, implementing programs to achieve the goals, and monitoring results; and developing a contingency plan for energy curtailment. An ECO case study analysis based on an industrial plant energy audit is detailed. Potential industrial energy conservation in the Tennessee Valley Region is discussed. (MCW)

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 55216, 55219, 55307, 55311, 55363

55206 (AD-A—050964) **Fort Belvoir regional energy survey. Final report.** Hollis, H.D.; Kukielka, C.A.; Baum, P.E. (Army Facilities Engineering Support Agency, Fort Belvoir, VA (USA). Research and Technology Div.). 26 Jul 1976. 56p. (USAFESA-RT—2014). NTIS PC A04/MF A01.

Each energy source crossing Ft. Belvoir's boundry has been studied. The major areas examined included consumption, supply and cost. From this information opportunities have been identified that offer tangible return on investment. General remarks are followed by a more indepth review. Backup data are presented in the appendix.

55207 (BNL—24371) **Multiobjective analysis in a National energy system model.** Schank, J. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 7p. (CONF-780450—2). Dep. NTIS, PC A02/MF A01.

From 9. conference on modeling and simulation; Pittsburgh, PA, USA (27 Apr 1978).

Multiple criteria are required to fully characterize the quality of any energy system. Past multi-objective analyses performed with the Brookhaven Energy System Optimization Model have relied upon the generation of pair-wise tradeoffs between competing objectives. This process proved computationally burdensome. This study develops an automated methodology for such analyses. Both the previous and automated procedures are executed upon a variant of the 1985 National Energy Plan scenario and the respective results are compared.

55208 (HCP/M1834—01) **Methodology for energy management plans for small communities. Final report.** (Sizemore and Associates (USA)). Jul 1978. Contract EA-77-X-01-1834. 171p. Dep. NTIS, PC A08/MF A01.

Sizemore and Associates, Architects and Energy Planners, developed a methodology for creation of energy-management plans suitable for use by small communities, which they can quickly apply themselves without extensive equipment, resources, data, or expertise. It was determined that through the involvement of the community the resulting energy-management plan would have the most success of support and implementation; in addition, choices of strategies that a community might take would be narrowed down as the community identified what mattered to them. The methodology in this report then becomes a series of steps which a community can take to identify its motivations for creating a plan, what its goals are,

the possible modifications it can make to its physical environment or community life, and then quickly evaluate and describe the impact the various modifications might have so that they can decide what to do first. This flowchart should enable a community to avoid the misdirected efforts normally encountered. The methodology that Sizemore and Associates developed has been developed in conjunction with an energy-management study of LaGrange, Georgia, a small community with a population of 26,000 with outstanding leadership in the local government; an extremely capable local utility director; the commitment of the citizens to actively participate in energy-conservation efforts; and the stability of a long-established textile industry as well as the development of several new industries not associated with textiles.

55209 (UCRL—81357) **Energy modeling at the Lawrence Livermore Laboratory.** Schrot, M.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1978. Contract W-7405-ENG-48. 13p. (CONF-780691—1). Dep. NTIS, PC A02/MF A01.

From Workshop on validation of mathematical models; Dallas, TX, USA (21 Jun 1978).

The Energy and Resource Planning Group is developing a capability in large-scale modeling of the energy economy. Energy analysts and programmers at LLL have developed software and a special input language for representing markets and economic processes and solving for market-clearing prices and quantities. This Economic Modeling System (EMS) develops a general-equilibrium model similar to one used several years ago in connection with a coal-gasification decision. EMS has been exercised upon a regionalized data base for energy flows in the U.S. The result is an Energy Policy Model (EPM), which, like the overall EMS, is the object of ongoing refinements. EPM is a regionalized model in which flows are conceptualized in a network with energy production (resource) nodes at the bottom and end-use nodes at the top. The flow moves up through a variety of process and transportation nodes. EMS consists of four district computer programs, INPUT, SOLVE, PRINT, and PLOT. The program INPUT requires two files—a network file and a parameter file—to produce a preliminary work file. The network file describes energy flows in the symbolic language that INPUT recognizes, while the parameter file provides all necessary data. INPUT generates a preliminary market structure, a sequenced network of market, process, and transportation nodes with fully specified sub-models attached to the nodes. This preliminary market structure, which does not contain the prices and quantities that will appear in all subsequent market strucutres, is saved as the file WORKA.

55210 **Energy flow diagram of the Federal Republic of Germany for the year 1976.** Hildebrandt, R. *Glueckauf;* **114**: No. 6, 271(Mar 1978). (In German).

55211 **Energy application in final consumption. Analysis, planning, techniques.** Zimmer, T. *Ind.-Anz.;* **99**: No. 92, 1850-1853(Nov 1977). (In German).

This report, which analyses the future development of energy consumption on a number of sectors, deals with the following topics: (1) energy conservation - wishes and realities; (2) sectoral macro- and microanalysis of energy consumption in the manufacturing industry; (3) analysis of the final consumption in the West German chemical industry; and (4) sectoral macro- and microanalysis of energy consumption in transportation.

55212 **Modeling energy-economy interactions: five approaches.** Hitch, C.J. (ed.). Washington, DC; Resources for the Future, Inc. (1977). 310p. (CONF-770526—P1). Resources for the Future, Inc., 1755 Massachusetts Ave., N.W., Washington, DC $7.50.

From ORSA/TIMS meeting; San Francisco, CA, USA (May 1977).

A separate abstract was prepared for each of 4 of the 6 papers. The objective was to determine the severity of the impact on key U.S. macro-economic variables during the transition from oil and natural gas to other sources of energy. Two papers were abstracted previously: EPRI-EA--592 (EAPA 4: 2289) and BNL--22735 (EAPA 4: 1363). (MCW)

55213 **Economic, energy, and environmental consequences of alternative energy regimes: an application of the RFF/SEAS modeling system.** Ridker, R.G.; Watson, W.D. Jr.; Shapanka, A. pp 135-198 of Modeling energy-economy interactions: five approaches. Hitch, C.J. (ed.). Washington, DC; Resources for the Future, Inc. (1977).

From ORSA/TIMS meeting; San Francisco, CA, USA (May 1977).

RFF/SEAS (Resources for the Future/Strategic Environmental Assessment System) is a system of interlinked models, the core of which is the University of Maryland's dynamic input-output model of the U.S. economy, INFORUM. Other models developed in the original SEAS project include components involving physical and monetary variables associated with energy, non-fuel minerals, transportation, and the environment (pollution, abatement costs, and environmental quality) at both the national and regional levels. This paper reports on an application of the RFF/SEAS modeling system to a set of specified questions and assumptions about the economic, energy, and environmental consequences of alternative scenarios with respect to the U.S. during the next fifty years. These scenarios explore the way the economy, as reflected in this modeling system, might behave in cases where it is difficult to satisfy energy requirements. For this purpose four basic scenarios are developed. Two involve cases incorporating substantial increases in energy prices but in which capacity to satisfy demands at those prices is relatively unconstrained. The other two add stringent restrictions on the use of coal, shale, imported oil, and nuclear power, the last being phased out completely by 2010, and assume that the price for new energy systems (for example, solar, biomass conversion, and sophisticated ways of increasing recovery rates for petroleum and natural gas) that can replace other non-electric sources would be substantially higher than in the first two cases. Within each set, the runs differ only with respect to the degree to which the economy can substitute other inputs for energy, the low substitution cases assuming a long-run price elasticity of demand for energy of -0.25 and the high substitution cases assuming -0.75.

55214 **General equilibrium two-sector energy demand model.** Reister, D.B.; Edmonds, J.A. pp 199-246 of Modeling energy-economy interactions: five approaches. Hitch, C.J. (ed.). Washington, DC; Resources for the Future, Inc. (1977).

From ORSA/TIMS meeting; San Francisco, CA, USA (May 1977).

In this model the two sectors are energy and the rest of the economy, which is called materials. In this context general equilibrium means that there are strong interactions between the two sectors of the model. The model was developed to provide long-term (25 to 50 years) forecasts of energy demand and GNP. The model can be used to study: (1) the economic impact of the transition from inexpensive energy sources (petroleum and natural gas) to more expensive energy sources; (2) the consequences of modifying the historical relationship between growth in GNP and growth in energy; and (3) the impact of large increases in the price of energy on economic growth (the energy price at which the economy is no longer viable). In this paper the theoretical aspects of the model are fully developed, but the application of the model is restricted to the first application. The other applications will be explored in a future paper.

55215 **What have we learned from these scenarios.** Lave, L.B. pp 278-303 of Modeling energy-economy interactions: five approaches. Hitch, C.J. (ed.). Washington, DC; Resources for the Future, Inc. (1977).

From ORSA/TIMS meeting; San Francisco, CA, USA (May 1977).

Mr. Lave reviews four of the energy-economic models discussed at this meeting, as well as the paper, Energy-Economy Interactions: The Fable of the Elephant and the Rabbit, by Hogan and Manne, which employs a one-sector model to examine the Btu/GNP ratio as a function of elasticity of substitution. He concludes that the nation ought to be focusing on energy use in 2010 in the range of 100 to 130 quads, rather than the 200 to 300 quads forecast. Policy, particularly DOE, ought to be directed at finding ways to increase the elasticity of substitution of other factors of production for energy. (MCW)

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 54509, 55106, 55107, 55212, 55213, 55214, 55230, 55242, 55245, 55248, 55249, 55250, 55252, 55265, 55270, 55274, 55279, 55282, 55293, 55295, 55303, 55341, 55363

55216 (BNL—50836) **Less Developed Countries Energy System Network Simulator, LDC-ESNS: a brief description.** Reisman, A.; Malone, R. (Brookhaven National Lab., Upton, NY (USA)). Apr 1978. Contract EY-76-C-02-0016. 80p. Dep. NTIS, PC A05/MF A01.

Prepared for the Brookhaven National Laboratory Developing Countries Energy Program, this report describes the Less Developed Countries Energy System Network Simulator (LDC-ESNS), a tool which provides a quantitative representation of the energy system of an LDC. The network structure of the energy supply and demand system, the model inputs and outputs, and the possible uses of the model for analysis are described.

55217 (P—5940) **More on insurance and catastrophic events: can we expect de facto limits on liability recoveries.** Solomon, K.A.; Whipple, C.; Okrent, D. (RAND Corp., Santa Monica, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA); California

Univ., San Diego, La Jolla (USA). Dept. of Physics). Mar 1978. 32p. Rand Corp., Santa Monica, CA.

The purpose of this study is to take an overview of large technological systems in society to ascertain the prevalence, if any, of situations that can lead to catastrophic effects where the resultant liabilities far exceed the insurances or assets subject to suit in court, thereby imposing de facto limits on liability recoveries. In part, interest in this topic is spurred by the continuing discussion and controversy over the Price-Anderson Act which requires operators of nuclear plants to waive certain defenses and which limits the combined liability of the operator and the government to an amount less than the maximum potential public cost of a major nuclear reactor accident. A variety of technological events could result in assignable liabilities up to $25 billion, or more, depending on the value of life. Aircraft crashes, chemical explosions, collision of ships, collapse of buildings during earthquakes, dams breaking, as well as nuclear accidents fall into this category. (MCW)

55218 Coping with new challenges to investment ventures abroad. Feldman, G.M. *Commer. Am.;* 3: No. 14, 3-5(3 Jul 1978).

The first of two articles examining recent developments in foreign investment focuses on how the changing perceptions of foreign governments has led them to alter their policies on foreign direct investment in response to the world economic situation. These changes are evident in the growing number of investment disputes that accompany the nationalistic trend of developing countries. Host governments, now demanding increasing control over foreign investment, can be more selective as other countries compete with American enterprises and the proportion of American investment declines. Both developed and developing host countries are requiring that direct investments be compatible with their own social and economic goals. New restrictions include government reviews of investment proposals and the screening out of new businesses that are inconsistent with national policy. Other changes include worker participation laws and a proposed international code of conduct for multinational corporations.

55219 Optimal investment strategy for boomtowns: a theoretical analysis. Cummings, R.G. (Univ. of New Mexico, Albuquerque); Schulze, W.D. *Am. Econ. Rev.;* 68: No. 3, 374-385(Jun 1978).

An investment model is suggested as an improvement over intuition in setting government policies aimed at providing an optimal social infrastructure for boom towns. Using the decision environment and economic characteristics of a Rocky Mountain state boom town, the model shows that low interest rates and early front-end investment produce the greatest stability, while delayed investment contributes to instability. Policy implications derive from the fact that ad valorem property taxes for investment are generally collectible only after construction is completed. Of equal importance to the timing and amount of investment funds is the source of repayment funds. These could be broadened to include wage or use taxes during the construction period.

55220 Interdependence versus self-reliance in economic relations. Vaeyrynen, R. (Tampere Peace Research Inst., Finland). *Alternatives;* 3: No. 4, 481-514(May 1978).

The process of change in international relations—characterized by the relative declining power of leading capitalist countries, by the increasing significance of socialist countries, and by the growing efforts in the direction of cooperation between Third World countries—may have profound implications for the emergence of new power constellations. But, for all the change, the overall international structure of economic relations (in terms of the orientation of trade and investment flows and the distribution of economic potential) has remained, by and large, intact, with the economic hegemony of the United States, within the West as well as internationally, still indisputable. Nevertheless, the change has posed a choice between two strategies of economic development, viz. interdependence and self-reliance, the one basically aimed at maintaining the structure of dominance-dependency relationship and the other at breaking out of it. The author analyzes both in their various aspects and shows which is best calculated to meet the basic human needs of all. 63 references.

55221 Relationship between energy and GNP. Kraft, J. (National Science Foundation, Washington, DC); Kraft, A. *J. Energy Dev.;* 3: No. 2, 401-403(Spr 1978).

This note reports results of an empirical test for determining the causal relationship between energy and gross national product. According to a current view, there is a constant and unchanging relationship between gross energy consumption and GNP. A logical corollary is that energy conservation is an unacceptable policy option since it would adversely influence economic activity. This implies that the direction of causality runs from energy to GNP as well as the other way around. With regard to the issue of causation, Sims (J. Am. Statis. Assn., Mar 1972) developed a test for unidirectional causality, which he applied to test the existence of a causal relationship between money and GNP. In this note, the authors attempt to determine both the empirical relationship between gross energy inputs and GNP and the presence of a causal link between these variables. The main empirical finding is that causality is unidirectional, only running from GNP to energy for the postwar period, and there is no causality from energy to GNP.

55222 Regional impacts of rising energy prices. Miernyk, W.H.; Giarratani, F.; Socher, C.F. Cambridge, MA; Ballinger Publishing Company (1978). 154p. $15.50.

The United States has survived the oil embargo of 1973 and appears to be adjusting to the dramatically higher prices for fossil fuels, which the embargo and other actions by the Organization of Petroleum Exporting Countries has engendered. The basic hypothesis of this study was that the new structure of energy prices, and future energy price increases, would have differential regional impacts in the United States. Consumers in all regions would, of course, pay more for energy. But energy-producing states, it was hypothesized, would benefit, while energy-consuming states would be adversely affected by the new price structure. It is still not possible to provide definitive proof that energy-producing states are gaining in economic well-being vis-a-vis energy-consuming states, but some indicators are evaluated to show that this is so. After an introduction and summary by Miernyk, he provides in Chapters 2, 3, and 4 an overview of the energy problem, the energy situation specifically in the Northeast, and reasonable estimates of the windfall gains enjoyed by the energy sectors and by energy-producing states between 1967 and 1974. In Chapter 5, Miernyk discusses energy prices in context of the Clark-Fisher development model. Chapter 6, by Frank Giarratani, explores the application of an input-output supply model to energy issues. The final chapter, by Giarratani and Charles F. Socher, deals with the pattern of industrial location under rising energy prices. It presents a brief discussion of the classical theory of location. The concept of income potential is then discussed, and state income potentials for 1970 and 1974 are calculated. (MCW)

55223 An unacceptable waste. Barnaby, F. (Stockholm Inernational Peace Research Inst.). *Mazingira;* No. 5, 6-11(1978).

World expenditures for military hardware and activities are argued to be an unacceptable waste in view of the limited and scarce raw materials. The waste of human talent that could be addressing health and social problems rather than engaging in military research is equally deplored. Statistics on military spending and consumption are summarized to show the magnitude of the burden, particularly on the developing countries. The international arms trade is shown to increase violence and the threat of nuclear war as well as causing serious ecological damage.

55224 Death of the gap theory. Biro, A. *Mazingira;* No. 5, 12-19(1978).

The author challenges the generally accepted theory that it is possible to bridge the gap between industrialized and non-industrialized countries by having the developing countries catch up. Although the experience in Europe since 1950 has been for only the minority to remain poor, this has not been true for the non-oil-rich Third World countries. One explanation for this may be the relative incorruptibility of the U.S tax system compared to the corruption and lack of equitable income distribution in the new African states. The idea that northern achievement is superior may be a myth is presented in new books, which the author finds hopeful because they do not perceive the north as a model and the only valid source of value judgment. A new concept of human development that is need-oriented rather than thing-oriented suggests an approach for self-reliance that is socially and environmentally sound.

55225 Technology for whom: someone must choose... Chagula, W.K. (Minister, Tanzania, East Africa). *Mazingira;* No. 5, 28-31(1978).

Using a question and answer format, the author describes the kind of appropriate technology that can provide Third World countries with basic needs. The primary requirements are that it be cheap and cost-effective and that it be socially, culturally, and environmentally acceptable. If the selection of technology to transfer is not based on closing the gap in terms of gross national product but rather on the basis of satisfying the population's human needs, new institutions for making decisions are needed. The idea of a south-south self-help approach is explored as a way for the developing world to accomplish self-reliance. Better-educated policymakers will be able to deal with technocrats in ways that will ensure the best transfer of technology to their country.

55226 Technology for whom: too dear to work. Stewart, F. (Inst. of Commonwealth Studies, Oxford). *Mazingira;* No. 5, 32-37(1978).

In spite of growth in per capita gross national product, less-developed countries (LDCs) continue to have large numbers of people who are unemployed and living in extreme poverty. The failure of advanced technology to create adequate jobs has led to a strong movement for more appropriate technology. Advanced tech-

nology is inappropriate because the capital costs per employee are too high to equip enough workers, plants are built on too large a scale for the market, and the combination creates an economic enclave which ignores the rest of the population. Appropriate technology gives priority to the basic needs of the poor and includes raising their income level by expanding productive employment. This requires inexpensive, small-scale technology that needs few skills and uses local materials. More technological research and development is needed in the LDCs as well as changes in the way income and investment resources are distributed, but this will entail changing the decision making process to include political and socio-economic considerations.

55227 Technology for whom: an adequate technology. Alva, E.N. *Mazingira;* No. 5, 56-62(1978).

The concept of human settlements technology (HST) is described and applied to the unique needs of developing countries having different cultural and climatic conditions. These countries are experiencing rapid growth in population, and appropriate technology should not be assumed to be the same as that used in industrialized counties in temperate climates. A new world order is asking that emerging countries define their own living patterns and determine which technologies are suitable for their whole population's needs rather than limiting modern technology to an elite. The author describes how unconventional, but creative, energy can be tapped for housing construction that is low-cost, self-sufficient, and easy to service. A plurality of life styles in tune with the ecosystem could be adopted, but this will require politicians and architects to approach eco-design as a creative rather than imitative process.

55228 Energy-economy interactions: the fable of the elephant and the rabbit. Hogan, W.W.; Manne, A.S. pp 247-277 of Modeling energy-economy interactions: five approaches. Hitch, C.J. (ed.). Washington, DC; Resources for the Future, Inc. (1977).

From ORSA/TIMS meeting; San Francisco, CA, USA (May 1977).

The energy sector cannot be treated in isolation, but the full interdependence effects must be considered. The economy is represented in terms of just two inputs--energy and all other items. Note that energy is only a small component of the U.S. economy. As of 1970, the value of primary energy inputs did not exceed 4% of the GNP. At 1970 or even at current prices, this is something like an elephant-rabbit stew. If such a recipe contains just one rabbit (the energy sector) and one elephant (the rest of the economy), won't it still taste very much like elephant stew. A simple model is constructed for organizing the central concepts and the parameters that might underlie a more realistic study. The aggregate model provides insights and indicates the possible range of energy policy impacts upon the economy as a whole. The metaphor of the elephant and the rabbit applies to an aggregate view of the economy with a single output and two inputs. If this approximation is accepted and if certain accounting conventions are adopted, it is straightforward to manipulate static comparisons of this model. The appendix records the aggregation and accounting conventions, summarizes the development of the two-factor model, and develops its application. An extension is presented to illustrate the possible relationship between energy and capital inputs.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 54352, 54942, 55213, 55233, 55238, 55240, 55252, 55287, 55319, 55851, 55879

55229 (ANL/EES-CP—11) **Transportation Energy Conservation (TEC) environmental development plan.** Bernard, M.J. III. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 22p. (CONF-7805102—1). Dep. NTIS, PC A02/MF A01.

From Highway vehicle systems contractors meeting; Troy, MI, USA (9 May 1978).

The Environmental Development Plan (EDP) is one component of the DOE Program Planning, Budgeting, and Review cycle and is the basic environmental planning document identifying environmental issues and scheduling appropriate research and analysis for all DOE energy systems. As an environmental planning document, the EDP must set out a schedule for responding to the guidance of the National Environmental Policy Act of 1969. The broad goal of NEPA is shown--an act requires the preparation of Environmental Impact Statements (EIS) for major Federal actions significantly affecting the quality of the human environment. The process, as implemented by DOE, to produce an EIS for a technology program or demonstration is expected to have, in chronological order, (a) an EDP with annual updates, (b) an environmental assessment (EA), a negative determination (ND) or a draft environmental impact statement (DEIS), and (c) a final environmental impact statement (EIS). The EA is a decision-making document, because it details the expected environmental impacts thus allowing the decision between preparing ND or a DEIS. Public reviews of the DEIS are held for revisions before the EIS becomes finalized. In 1977, Argonne National Lab. developed a pilot EDP for electric vehicles. This was done to demonstrate the EDP process (one had never been written for any technology) and to identify EV issues and resolution strategies. During the summer, a TEC Programmatic EDP was prepared for thirteen TEC technologies--Stirling engine; gas-turbine engine; constant-speed accessory-drive system; bottoming cycle for heavy-duty trucks; continuously variable transmission; new hydrocarbons--broad-cut petroleum fuels; alcohol fuels; synthetic fuels; advanced fuels--hydrogen; electric vehicles; hybrid vehicles; pipeline bottoming cycle; and stratified-charge concept.

55230 Older workers SEE a better environment. Morehouse, K. (Environmental Protection Agency, Washington, DC). *Worklife;* 3: No. 7, 26-29(Jul 1978).

The Environmental Protection Agency (EPA) and the Administration on Aging (AoA) sponsor the Senior Environmental Employment (SEE) program, which hires 200 older workers in 10 states for various pollution-control programs. These include monitoring and collecting data on environmental problems, such as chronic noise pollution and water treatment problems in Allentown, PA. The program provides older workers with useful work and an income, while enabling communities to proceed with pollution projects that are difficult to fund in local budgets. The SEE employees are 55 or older and have a range of skills and incomes. Their work must augment rather than replace existing agency operations.

55231 Public land withdrawals. Laxalt, P. (Senate, Washington, DC). pp 6p, Set No. 1, Paper 2 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

A coalition of 30 senators from Western states has been formed to promote a unified presentation of Western USA problems in water rights, public lands management, states rights, etc. Legal and legislative aspects of the problems are emphasized. (LTN)

55232 Crucial issues facing the mining industry. Barber, C.F. (ASARCO Inc., New York). pp 10p, Set No. 1, Paper 4 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

The continued viability of the domestic mining industry is being taken for granted in Washington while the industry is being suffocated by government rules, regulations and just plain red tape, according to the aurthor. The iddustry is like Gulliver, a robust giant being tied down by a million silk strands. Each strand has its narrow explanation and vocal advocates—but it also has its cost, and there is no one looking out for Gulliver. It is late in the day. U.S. dependence on imported raw materials will increase unless government policymakers pay greater heed to the effects on the mining industry of other federal programs and policies. These include new regulations affecting land use, the environment, worker health and safety, taxation, international economic policy and, of course energy.

ENERGY RESOURCES

REFER ALSO TO CITATION(S) 54510, 55231, 55232, 55280, 55390, 55861

55233 (CONF-780201—, pp 5-13) **New energy era.** Freeman, S.D. (Tennessee Valley Authority, Knoxville). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

Mr. Freeman first reviewed the last ten years of activities (energy-wise and environmental aspects) at the Tennessee Valley Authority and in the nation as a whole. Basic environmental protection laws have been passed, nuclear safety standards have been formulated, and the 1978 coal strike underscored the importance of having a diversity of energy systems. The nation is progressing in the energy field except in the oil crisis and in the transportation sector. The nation is dependent more and more on Middle East oil where the supply is going to peak and run out. Mr. Freeman strongly feels that the electric car and electrifying the railroads seem to be sensible ways for this region and the nation to keep their mobility and independence. Progress and success of nuclear power plants installed by TVA are discussed. TVA's successful reforestation projects and the installation of scrubbers at the power plants are cited. Mr. Freeman believes solar energy applications in the Tennessee Valley are economical for water and space heating. TVA began as an environmental protection and conservation agency. Water that

was being lost to the sea was harnessed and transformed into kilowatts and TVA restored a green cover to the valley. (MCW)

55234 (DOE/EIA—0008/1(78)) **Energy Information report to Congress. Quarterly report: first quarter 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1978. 93p. Dep. NTIS, PC A05/MF A01.

Detailed data are compiled on energy in the United States. Oil and gas exploration and development are covered in Section 2. Section 3, Coal, covers information on production, consumption, stocks, imports, exports, and reserves. Natural gas data are compiled in Section 4. Section 5 on petroleum covers the following: supply and demand, crude oil production, imports, refinery input and output, demand by type of product, inventories, and crude oil allocation program. Section 6 on nuclear energy covers: status of domestic nuclear power plants; operating power plants; nuclear power plant construction programs; capacity projections and requirements; supply of nuclear fuel materials; and policy, decisions, and issues. Sales of electricity, imports and exports, production of electricity, primary energy consumed by power plants, power plant conversion efficiency, and fuel stocks at power plants are data covered in the last section on electric power. (MCW)

55235 (DOE/EIA—0035/5) **Monthly energy review.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 98p. (NTISUB/D/127—005). Dep. NTIS, PC A05/MF A01.

An article, Short-Term Petroleum Supply and Demand, by the Office of Energy Source Analysis, Office of Applied Analysis, presents analyses of projections of U.S. energy supply, demand, prices, and their impacts. The petroleum supply and demand short-term forecasts, with a discussion of those forecasts and the factors influencing them, are also presented. Part I is an overview. Then data are compiled in the following energy areas: crude oil and refined petroleum products, natural gas, coal, electric utilities, nuclear power, energy consumption, resource development, prices, and international aspects. (MCW)

55236 (PB—277501) **Lead - 1977.** Ryan, J.P.; Hague, J.M. (Bureau of Mines, Washington, DC (USA)). Dec 1977. 28p.

Lead is one of the most useful and essential metals in the service of man. Its major uses are storage batteries for automobiles and battery-powered vehicles, as an antiknock additive in gasoline, and in materials for the construction industry. The United States has the largest reserves of lead and has been the leading lead-producing country for several years. This report presents comprehensive data for the commodity including background material on industry structure, reserves and resources, technology, supply-demand relationships, byproducts and coproducts, strategic considerations, economic factors and problems, environmental considerations, operating factors and problems, and outlook to 2000.

55237 (PB—277639) **Vanadium - 1977.** Broderick, G.N. (Bureau of Mines, Washington, DC (USA)). 1977. 18p.

This report, with pertinent references, is a comprehensive description and analysis of the vanadium industry. Included is information on industry structure, size and organization; definitions, grades, and specifications; reserves and resources; geology; production and capacity; uses; technology; byproducts and coproducts; strategic considerations; economic and operating factors and problems; supply-demand relationships; and forecasts of supply and demand. Vanadium is used principally as an alloy in steel. Other important uses are in titanium alloys and in various chemical catalytic processes. The world supply of vanadium is sufficient to last far beyond the year 2000 at the present and projected rates of consumption. Almost all of the resources will economically yield vanadium only in conjunction with a coproduct.

55238 **Changes in the mining law.** McClure, J.A. (Senate, Washington, DC). pp 6p, Set No. 1, Paper 1 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Any change in federal mining law must recognize the following points: (1) it must follow the policies established in the Mining and Minerals Policy Act of 1970—i.e., mining policy must encourage private enterprise; assure that industrial, security and environmental needs are considered; utilize the nation's research and recycling abilities; and develop methods for reclamation of mined land and waste products; (2) there must be sufficient incentive for the small and large-scale prospector to continue the search for needed minerals—with the assurance that their discoveries can be given a strong measure of protection of title, as well as a protection of tenure, and with minimum government interference; (3) we must recognize that minerals are where you find them; and special consideration must be given to the opportunity to explore those areas that have mineral potential; (4) we must learn from experience and not become overly dependent on foreign sources for any material; and (5) any definition of the word "environment" must include those economic, social, and natural factors that contribute to man and his quality of life. All of these principles are compatible with protecting public lands from environmental abuse and are essential if a strong domestic mining industry is to be maintained. The Udall and Metcalf bills do not embrace these goals. The deleterious effects of changes in strategic materials stockpile objectives that have nothing to do with defense are also discussed.

55239 **Statutory inhibitions on Alaska mineral development.** Stevens, T. (Senate, Washington, DC). pp 7p, Set No. 2, Paper 1 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

All mining operations involve dealing with multiple Federal and state departments, agencies and bureaus. This fragmentation is symptomatic of what's wrong with our present system. The problem resides not so much in the legislation but its implementation and application. Ninety-five percent of Alaska is presently Federal land, and 99 percent of statutory inhibitions to Alaskan mineral development result from misdirected Federal legislation. The Clean Air Act amendments of 1977 impose rigid emission standards on and adjacent to Federal lands. The Clean Water Act, again, demonstrates a triumph of arbitrary regulation over common sense. Water quality standards hold miners to standards higher than nature. The mining industry should not be required to improve the water quality of creeks and streams already polluted by nature. The strip mining bill offers a third example. Starting from a valid first premise, disturbed land should be restored, a series of arbitrary restrictions fail to recognize the imperatives of reality. The dramatic topography of Alaska resulted from accidents of nature. It is impossible to recreate the contours resulting from earthquakes, floods, glaciers, or volcanos. However, advanced technology can achieve equal beauty and greater utility in restoring mined areas: top soil can be distributed for farming; gravel can be employed for stabilization; and lakes and pastures and parks can be created in response to a specific state's specific needs. Yet these options are virtually eliminated by original contour and glacial valley restrictions. These, at worst, may prevent mining despite an energy crisis and, at best, will accelerate inflation by passing through unnecessary, exorbitant costs to the consumer.

55240 **Mineral potential of Alaska.** Hickel, W.J. pp 5p, Set No. 2, Paper 2 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Alaska has 31 of the 33 most important minerals used by modern industry and huge coal reserves (one trillion tons in readily accessible areas and up to eight trillion tons in less accessible areas), as well as the oil reservoirs at Prudhoe Bay. A plea is made for the national development of these resources and not to have the major part of Alaska designated as a wilderness area. A further suggestion is for a railroad system from Fairbanks to Prudhoe Bay; also west to the Bering Sea and east to connect with the Canadian system. A considerable part of Alaska will remain a wilderness whether it is designated or not. Hickel wants resource development with reasonable environmental protection. (LTN)

55241 **State response to Federal resource regulation.** Matheson, S.M. (Governor, State of Utah). pp 14p, Set No. 2, Paper 4 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Gov. Matheson discusses problems of state and Federal legislation in areas of energy development, coal mine leasing water resources, and environmental and safety areas. Notwithstanding a desire to take the lead in such matters, the state often plays a role of uncertain scope because of the preeminence of the Federal Government. Seventy percent of the land in Utah is owned by the Federal government (if Indian lands are included). Consequently, the key decision as to the purpose for which a particular tract of ground may be used often rests with the Federal government, while the state remains advisory. The Federal government, with its responsibilities to the general public for management of public resources, thus dictates conditions under which mining may take place. It is a challenge for those in state government just as it is for those in industry, to keep abreast of new Federal legislation and regulations. States should consciously seek to define the means available to ensure effective participation in formulation and implementation of resource recovery policy, and then assert aggressively the state interest through such means. Though constitutional limits on state powers do exist, the state, through exercise of its policy power, can regulate mining activities to a certain extent, even though such activities take place on Federal lands. Such state regulations control,

in the absence of legislation by Congress on the subject, through operation of the property clause and the supremacy clause of the constitution. However, regulation by Congress of public-domain land overrides conflicting state regulations. Within these constitutional limitations, the states can, and should, play a meaningful role in resource development.

55242 Emerging concept of Indian sovereignty and it's impact on mineral development. von Ammon, P.E. (Fennemore, Craig, von Ammon and Udall, Phoenix, AZ). pp 12p, Set No. 2, Paper 5 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Legal problems in operating on Indian tribal-owned land are described. These are quite complex and the relevant law is different from other state and US laws, since the Indians have an essential sovereignty over their reservations, the limits of which are uncertain (based on treaties, congressional action or executive order). Several examples of such legal problems are described. (LTN)

55243 Resource recovery planning: an overview of the implementation process. Washington, DC; National League of Cities United States Conference of Mayors ([nd]). 26p. $3.00.

Resource recovery increasingly is becoming a major concern of city officials. Cities that undertake effective resource-recovery programs can benefit in two ways. First, the volume of solid waste can be significantly reduced, thus prolonging the life of existing landfill sites. Second, resource recovery can produce revenues that will offset, at least in part, refuse collection and disposal costs. However, no city should undertake resource-recovery activities with the expectation that a profit will be made. Third, there is an increasing appreciation of the fact that the nation's resources are finite. City officials may begin considering resource recovery in anticipation that the recycling of consumed materials may become national policy. Successful implementation and management of resource-recovery facilities is a difficult and complex venture for city officials. This report outlines the critical components of the implementation process. The guide covers the issues of mixed waste recovery: large-scale, capital-investment projects that require precision planning and analysis of the financial, technical, and administrative considerations.

RESEARCH AND DEVELOPMENT

REFER ALSO TO CITATION(S) 55223, 55226, 55307, 55322

55244 (CONF-780201—, pp 57-64) **Energy research and development prospects.** Willis, E.H. (Dept. of Energy, Washington, DC). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

Dr. Willis first reviewed the status of the research effort of DOE, comparing it to the status and concerns of research activities in the USSR. He observed that the Russians take extraordinary measures to solve their problems, that they have the capacity to solve their problems, and that they have the initiative "to get going with the job." The will to "get going" is noticeably absent in our system. Our problem then is to focus the will of the American people on a problem that some say is fiction—they believe there is no problem. But the problem of energy supplies exists. Energy conservation and all forms of near-term alternative energy sources must be employed to their limit. Dr. Willis does not expect any extraordinary technological break-through by 1985. Our principal job, then, is to get research going now for the long-term. Specifics are examined—overcoming the constraints on coal utilization, liquids for the transportation sector, light-water reactor operation, advanced nuclear options, renewable energy sources, solar systems, and fusion energy.

55245 Authorizations for Depa:tment of Energy civilian programs: Fiscal Year 1979. Report of the Committee on Energy and Natural Resources, United States Senate, Ninety-Fifth Congress, Second Session together with additional views to accompany S. 2692. Washington, DC; Committee on Energy and Natural Resources (1978). 309p. GPO.

S.2692 authorizes appropriations for th civilian programs of the Department of Energy for fiscal year 1979. President Carters' total proposed budget for the civilian programs of the Department of Energy is $9,886,296,000 for fiscal year 1979. As discussed here, the Committee recommends an increase of $420,700,000 for a fiscal year 1979 total of $10,306,996,000. The recommendations of the Committee on Energy and Natural Resources are summarized and their budgetary impact is discussed. Major provisions in the bill include: research and technology development; production, demonstration, and distribution; conservation; regulation; emergency preparedness; energy information; environment; policy and management; general science and basic research; power marketing administrations; geothermal resources development fund; special foreign currency; miscellaneous revenues; provisions applicable to annual authorization acts; competition in crude oil sales; retroactive application of certain rules, regulations, and interpretations; prohibition on entitlement subsidy to importers of residual fuel oil and refined petroleum products; amendment to Solar Heating and Cooling Demonstration Act of 1974; National and regional energy studies; National Alcohol Fuels Commission; and automobile fuel economy study. Budgets for energy supply-research and technology development program are given for coal, petroleum, natural gas, solar, geothermal, magnetic confinement fusion, fission, breeder reactor, hydroelectric, biomass, and basic energy sciences. (MCW)

55246 (PB—276195) **Design of experiments using Federal innovation processes. Volume I. Final report.** Milbergs, E.; Williams, C.W.; Quick, R.E. (Stanford Research Inst., Menlo Park, CA (USA)). Jan 1976. Contract NSF-C-828. 238p. NTIS PC A11/MF A01.

The objective of the research is the development of a natural experimental design framework to examine the effects of various federal incentives on the amount and rate of civilian technological change. The research focuses on a set of federally sponsored innovations and associated government policies that influence the factors determining the ultimate commercial viability of such innovations. The recommended experiments can provide a basis to evaluate the effectiveness of various federal policies and incentive strategies in providing the adoption of federally sponsored innovations. The methodology for developing experiments entails selecting and documenting nine case studies of federal civilian RandD programs and projects expected to be commercially adapted and marketed by a private sector company primarily for the nonfederal market.

55247 Towards new national policies to increase industrial innovation. Press, F. *Res. Manage. (N.Y.);* **21**: No. 4, 10-13(Jul 1978).

From Symposium on innovation and innovation centers; Cambridge, MA, USA (18 May 1978).

The Industrial Innovation Coordinating Committee has been appointed by President Carter to examine the issues and problems of industrial innovation and set policy options that will stimulate more effective innovation. Domestic and global economic realities justify a sense of urgency. Barriers to innovation include market uncertainties and market fragmentation, managerial philosophy that emphasizes short-term profits, and federal regulations. It is pointed out, however, that before the advent of product standards, scientific uncertainty also led industry to be conservative. Emphasis in the new effort will be to identify ways the government can indirectly promote innovation, such as tax incentives. A re-evaluation of the role universities should play in research is likely to conclude that most basic research should remain there. The initiative for innovation will have to deal with the new energy, resource, and environmental constraints. It will have to promote institutional innovation, better organization, and more responsiveness to the need for change.

55248 Technology for whom: the nature of western technology. Reddy, A.K.N. *Mazingira;* No. 5, 20-27(1978).

Seven principal features are outlined to illustrate the pattern in which technology is shaped in response to social wants, which are themselves shaped by technology. The author points out that spontaneous innovation by the general populace has been replaced by institutionalized research and development programs that tend to serve only those who can afford it and ignore the poor. A sequence of events can be schematically drawn to illustrate the innovative chain. The innovative process is influenced by socio-economic and environmental constraints, which affect decisions along the chain. Consistency with social values will, along with technical efficiency, be a factor in whether a technology is utilized. The pattern emerges in the West as an orientation toward energy-intensive private luxury goods and military applications. This amplifies social and economic inequality and increases both social alienation and environmental damage. The demand for a new world economic order is an effort to modify this pattern.

55249 1979 Department of Energy authorization. Volume II. Fossil fuels research. Hearings before the Committee on Science and Technology, U.S. House of Representatives, Ninety-Fifth Congress, second session. Washington, DC; Committee on Science and Technology (1978). 733p. GPO.

The Subcommittee of Fossil and Nuclear Energy R, D, and D met on Jan. 26, 1978, to begin the hearings on the 1979 authorization budget for fossil-fuel research. The hearings were structured around the near-term fossil-energy program. Energy conservation was cited as the main thrust of the short-term mitigation with alternative fuel resources being developed to the limit, especially coal. The organizing of the Office of Energy Research and the accomplishments to date in that office are reviewed. Dr. Eric Willis

reviewed DOE's overall thinking on fossil technology and Mr. George Fumich discussed that budget. Dr. W. B. Harrison, Sr., talked about large coal-burning electric utility systems, particularly the SRC process, which he prefers over coal-derived liquids or flue-gas desulfurization. Michael D. Dingman presented written testimony supporting SRC-fired plants while William F. Morse reported on the potential of Devonian shales. On Jan. 31, testimony concerned coal conversion, oil shale, and coal mining R and D. On Feb. 1, Dr. Richard A. Flynn reported that the SRC-II process had been operating successfully for a year at the Fort Lewis Pilot Plant using Kentucky coal, but that Illinois No. 6 and Pittsburg seam coal were acceptable. Other witnesses spoke on Hy-gas and U-gas processes, Devonian shales, peat deposits, advanced power systems, fuel cell and gas-turbine power plants, coal gasification combined-cycle program, and specifically, the Powerton Gasification Combined Cycle Test Facility. The Feb. 9 tesimony dealt with the impact of the draft standards of performance for utility boilers on new and developing energy technologies. (MCW)

55250 1979 Department of Energy authorization (advanced energy technologies and energy conservation). Volume VI. Hearings before the Committee on Science and Technology, U.S. House of Representatives, Ninety-Fifth Congress, second session. Washington, DC; Committee on Science and Technology (1978). 585p. GPO.

The Subcommittee on Advanced Energy Technologies and Energy Conservation R, D, and D met Feb. 7, 1978 to hear testimony specifically from Drs. Marjouie and Aden Milund, who pointed out the potentials of solar energy. On Feb 8, information was presented about the Office of Energy Research and programs managed by it (basic energy sciences, high-energy and nuclear physics, and the new advanced technology and assessment projects). The Feb. 9 hearing dealt with authorization requested by the administration for programs in intergovernmental and institutional relations, international affairs, and program direction and management support. On Feb. 14 the following were heard: Rep. Lou Frey, Jr. (on ocean thermal energy conversion); Rep. Bob Grammage (on geopressurized and geothermal resources); Rep. Manuel Lujan (on geothermal energy experiment at Los Alamos); Rep. J. J. Pickle (on geopressured resource programs in Texas and Louisiana and fusion research at Univ. of Texas); Rep. James M. Jeffords (on budgets shortages in all advanced technology areas); Rep. Silvio O. Conte (on small site hydroelectric program, specifically for geothermal conversion); Rep. Floyd J. Fithian (on fuels from biomass); and Rep. Robert C. McEwen (on fuel from biomass). On Feb. 15 several organizations and businesses reported on solar energy, geothermal energy, thermionic energy conversion, and oil heat conservation. Finally, on Feb. 21, statements were presented by Dr. Chauncy Starr, president, Electric Power Research Inst,; Sheldon H. Butt, Solar Industries Research Ass'n; and Larry E. Paulick of the National Swimming Pool Institute. (MCW)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 54643, 54713, 54717, 54744, 55030, 55031, 55035, 55036, 55148, 55217, 55279, 55280, 55309, 56282

55251 (ORAU/IEA—78-8(0)) **Nuclear hostage: a new factor in the strategic equation.** Cooper, C.L. (Institute for Energy Analysis, Oak Ridge, TN (USA)). Jul 1978. Contract EY-76-C-05-0033. 22p. Dep. NTIS, PC A02/MF A01.

For the past three decades there has been peace, or at least an absence of war, between the Soviet Union and Eastern Europe, on the one hand; and the United States, Canada, and Western Europe, on the other. This, in large part, stems from their common recognition that war would carry unacceptable costs for both winner and loser. Under a regime of "Mutual Assured Destruction," each side, in effect, is in hostage to the other. As a consequence, there are self-imposed constraints against undertaking aggressive acts and an elevation of the threshold of what constitutes a casus belli. With increasing acquisition of nuclear power plants by an increasing number of Third World countries, an analogous situation may occur. Nuclear plants are vulnerable targets; a determined attack even with conventional weapons can hit the vital organs (e.g., the cooling and electrical systems) of nuclear plants. A meltdown, in turn, could result in very large and sustained damage. While the odds on such a successful attack are low, the consequences of such an attack could well be unacceptable. In short, the possession of a nuclear plant could place a country in hostage to both its neighbors and the good international behavior of its government. Under these circumstances a new factor in the Third World's strategic equation will be introduced.

55252 Economic and envionmental consequences of a nuclear power plant phaseout. Watson, W.D. Jr. (Resources for the Future, Inc., Washington, DC). *J. Energy Dev.;* **3**: No. 2, 277-317(Spr 1978).

Study groups have recently attempted to analyze the issues offered by proponents of halting nuclear power plant construction and those offered by groups in favor of nuclear energy. This paper also analyzes trade-offs, two alternative futures or scenarios for the U.S. being examined: one in which nuclear energy continues to grow at fairly rapid rates vs. one in which nuclear power plants currently operating and those actually under construction are allowed to operate for a normal lifetime but construction of any additional plants is halted. When it is possible and whenever it seems reasonable, the approach taken in this paper is to quantify the relevant trade-offs over the next 50-year period. While this time period is too short to observe the full, ultimate consequences of a nuclear energy phaseout, anything longer would reduce confidence in results to a level too low to make the effort worthwhile. The approach involves consideration of likely developments in each of the major factors that can influence the future in order to determine which assumptions are most reasonable to include in the projection exercise. These assumptions are then incorporated into a model of the U.S. economy that is run for each of the two alternative scenarios in order to estimate the relevant trade-offs. The model and key assumptions used in running both scenarios are described. Results are then compared first in terms of economic and resource impacts and then in terms of environmental impacts. Finally, trade-offs between the two scenarios are reviewed and conclusions given. (MCW)

55253 Canada: expanding nuclear fuel exports. Paehlke, R. (Trent Univ., Peterborough, Ont.). *Environment;* **20**: No. 1, 2-5(1978).

Uranium is soon to be a very big business in Canada and most of the expansion is bound for export markets. The expansions that are planned are both in uranium mining and in fuel processing. Almost all environmental problems associated with the nuclear fuel cycle thus far in Canada have been associated with these two phases of the cycle: mining and processing. The water in Elliot Lake has been found to have high concentrations of radium and the drinking water of Serpent River, Ontario—downwater from Elliot Lake—has been found to be contaminated by excess radioactivity. Buildings in both Port Hope, Ontario, and Uranium City, Saskatchewan (near Eldorado's Saskatchewan minesite), have excess radiation counts attributable to radon and radon daughter gases. Several aspects of the expansion are currently undergoing environmental impact assessment. Far and away the most careful and balanced inquiry is the Saskatchewan government-appointed inquiry under Mr. Justice E. D. Bayda of the Saskatchewan Appeals Court. This inquiry is, in the first instance, examining a proposal by Amok Ltee., a consortium of a French multinational and the French government, to develop a $135 million uranium mine and mill at Cluff Lake in the northern portion of Saskatchewan. But the inquiry is considering all aspects and implications of the full nuclear fuel cycle. The second stage of the uranium boom in Canada centers on processing. Here two major new plants are proposed by Eldorado Nuclear: one at Port Granby, Ontario; the second at Varman, Saskatchewan. Several massive nuclear power stations are planned east of Toronto, but nuclear opposition is growing in Canada. (MCW)

55254 Summary of studies on underground nuclear power plant siting. Bach, P.J. (Univ. of Minnesota, Minneapolis). *Underground Space;* **2**: No. 1, 47-51(Sep 1977).

Studies have been conducted to evaluate underground nuclear power plant siting. Studies reported and reactor types considered are: Aerospace Corporation for the EQL (pressurized water and boiling water); Harza Engineering Co. (pressurized water and boiling water); 1966 to 1969 cooperative power reactor study by NVE and IFA (boiling water and gas cooled); Bechtel Corporation and SCE (pressurized water); Central Operating Management (boiling water); and Swedish State Board (Chooz power plant). From the studies reported and from the simple fact that underground nuclear power plants are operating, it is evident that the construction technology is available. Economic feasibility, however, is dependent upon the individual situation, i.e., the individual nuclear reactor, plant design, and location being considered. The range of cost penalties is illustrated, and a listing of construction-time penalties is included. It can be seen that conclusions reached by these investigations regarding economic feasibility of undergrounding nuclear power plants vary widely. However, enough of the studies have reported in favor of underground nuclear power plants to indicate that underground siting is a possible alternative that can not be overlooked. Whether or not this type of siting will be used in the future will depend on studies still to be completed and the specific location being considered. 21 references.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 55322

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 54924, 55359

55255 (ANL/ICES-TM—3) **Municipal financing of Integrated Community Energy Systems.** Croke, K.; Baum, J.; Rosenberg, R. (Illinois Univ., Chicago (USA)). Nov 1977. Contract W-31-109-ENG-38. 59p. Dep. NTIS, PC A04/MF A01.

Growing concern regarding the impact of inflated energy costs on the provision of community services has created a need for communities to seek new methods of ensuring adequate energy at reasonably stable prices. Because one method--Integrated Community Energy Systems--offers promise, methods of financing such systems are discussed here. Various kinds of costs and available options of financing them--including advantages and disadvantages of each--are examined. Repayment schedules, methods of managing revenues, and selection of outside consultants are considered. Finally, scheduling of ICES projects is put into perspective in terms of performance evaluation and review technique (PERT) procedures.

55256 (ANL/ICES-TM—7) **Impacts of environmental and utility siting laws on community energy systems.** Senew, M.J.; Shimamoto, G.T.; Seymour, D.A.; Santini, D.J. (Argonne National Leb., IL (USA)). Feb 1978. Contract W-31-109-ENG-38. 320p. Dep. NTIS, PC A14/MF A01.

Community Energy Systems provide an interesting energy conservative alternative to the traditional trend of large, central, grid-connected power plant design. The small community energy system (generally smaller than 100 MW), provides for waste heat utilization and utility cogeneration significantly reducing a community's total energy demand. Developers of Community Energy Systems, unfortunately, are faced with a complex of environmental and siting regulations, most of which are aimed at regulating the development and design of large power-generating facilities. Aside from discouraging development of a potentially more economic and environmentally sound approach to power generation, air-pollution regulations discriminate against these smaller systems. Compliance with the many Federal, state and local regulations often make small energy systems uneconomical. This project studies the emissions associated with Community Energy Systems and reviews the Federal, state, and local laws that regulate their design.

55257 (COO—4212-3) **Technical and economic assessment of industrial and community co-generation concepts.** Dittrich, R.F.; Ku, W.S.; Mallard, S.A. (Public Service Electric and Gas Co., Newark, NJ (USA)). [nd]. Contract EC-77-C-02-4212. 8p. (CONF-780142—1). Dep. NTIS, PC A02/MF A01.

From Power Engineering Society winter meeting; New York, NY, USA (29 Jan 1978).

This paper presents an overview of cogeneration in the U.S. and Europe, a description of various approaches for assessment of cogeneration, and the preliminary results and conclusions of several recent investigations of cogeneration by the Public Service Electric and Gas Company (PSE and G) of Newark, New Jersey. Cogeneration provides an improved thermal output usage of an electric energy-conversion process. Although cogeneration results in overall fuel savings because of higher thermal efficiency, it puts additional strain on national oil consumption based on applying presently feasible technology. The economic and overall viability of cogeneration projects is most sensitive to site-related factors. Extensive applications of cogeneration concepts would reduce their economic competitiveness since cogeneration would then be evaluated against the installation of large base-load generating capacity, such as nuclear. The implementation of a cogeneration project must take into consideration all pertinent regulatory and institutional issues.

55258 **District-heating supply from the Duisburg AG municipal power station.** Wein, W. (Stadtwerke Duisburg A.G. (Germany, F.R.)). *Fernwaerme Int.;* 7: No. 2, 24-28(May 1978). (In German).

In the most built-up areas the Duisburg municipal power station operates a total of four district-heating systems. By far the largest of these in Duisburg-Mitte is supplied on the heat-electric principle. The operation and economics of this system were discussed. The operation of the system operation with constant water supply and varying system temperatures, with countercurrent supply from a peak power station are described.

55259 **District-heating and end energy in Nuernberg.** Kolar, J. (Energie- und Wasserversorgung A.G. (EWAG), Nuernberg (Germany, F.R.)). *Fernwaerme Int.;* 7: No. 2, 19-23(May 1978). (In German).

Domestic consumers and small users are involved in the ultimate energy consumption in Nuernberg to the extent of about 60%. This group is mainly supplied with up to 30% with power supplied by electric power. The contribution from district-heating is 5%, which at the moment is covered by 5 independent systems. To complete the program for future investment the construction of a central district-heating system is planned from which a thermal-electric station in the center of the city will supply the areas Inner City, Langwasser and Fuchsstrasse. It is demonstrated that the heating system is an efficient, cheap and rapidly achieved means for energy saving.

CONSERVATION

REFER ALSO TO CITATION(S) 55229, 55243, 55298, 55322

55260 (CONF-780201—, pp 149-155) **Project Pacesetter: the Pittsburgh Community Energy Program.** Lynch, L. (United Steelworkers of America, Pittsburgh). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

Project Pacesetter, a community-oriented program, seeks to effect public awareness of the issues involving energy conservation. Together with leaders in education, local government, business and industry, the public interest sector, and voluntary organizations, Steelworkers President Lloyd McBride has taken a task force and overall leadership role in Project Pacesetter. Some of the things being effected in Allegheny County and Pittsburgh as a result of some seven months of work by the task force of Project Pacesetter are presented: (1) Through efforts with the Greater Pittsburgh Board of Realtors, the National Home Improvement Council, the Carpenters District Council, and other groups, a free home energy audit is being offered, with a printout offered to homeowners. Through this printout, owners will know how to tighten up their homes and save energy. (2) The schools are in the process of adopting an energy curriculum to bring an awareness to thousands of public and private school students of the necessity of energy both in school and at home. (3) In several of the shopping plazas of the Greater Pittsburgh area, a model retrofitted home was constructed to graphically show the need for insulation, weather stripping, and other home winterizing projects. (4) Residential energy contests and a renewal of recycling programs emphasizing newsprint are in the works. (5) And finally, the Business and Industry Task Force is now involved with the appointment of energy managers for most businesses in the county and the establishment of energy-management workshops to assist them. It is too early to assess the results of this local undertaking. (MCW)

55261 (CONF-780201—, pp 157-163) **Energy Extension Service.** Savitz, M. (Dept. of Energy, Washington, DC); Pitts, D. May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

The Energy Extension Service was created to provide technical assistance to small businesses and homeowners. It not only distributes information, but provides practical assistance. A pilot program was embarked upon to see what would be the best way to set up a national program. Different states have different unique abilities and different problems, Dr Sovitz says. An 18-month pilot program was established. Forty-nine states and the District of Columbia competed for what was going to be ten awards, and about $1.1 million is going to each of the ten states. The ten states selected include Tennessee, Alabama, Connecticut, Pennsylvania, New Mexico, Wyoming, and Wisconsin. Also, $30,000 is going to the other states in order for them to follow what's going on in the ten pilot states. A year from now they will be ready to start the program and will have learned from the other experiences. Don Pitts then described the activities and organization of the Tennessee Extension Service program, which focuses on three specific geographic locations, representing the three grand divisions of the state and also representing three very different-size communities. These are Kingsport and Sullivan County, Nashville and Davidson County, and Paris and Henry County. The first of these, of course, is a moderate-sized East Tennessee area with a good mix of industry and the agriculture of that region. The second is a major metropolitan area of Middle Tennessee. And, of course, the third is a smaller-size West Tennessee city with typical West Tennessee agriculture and a good range of industrial activity in that area. In each county and city region, attention is directed toward five different target groups, namely: urban residential; rural residential and farmers; small businesses and industry; city and county governments; and what is grouped as the mortgage loan and realty area. The services performed and offered in each area are detailed. (MCW)

55262 (DOE/CS—0043) **Driver Aid and Education Test Project. Final report.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Jul 1978. 140p. Dep. NTIS, PC A07/MF A01.

The Driver Aid and Education Test Project was initiated by the Department of Energy in order to test the hypothesis that

measurable improvements in fleet fuel economy can be achieved by driver awareness training in fuel-efficient driving techniques and by a manifold vacuum gauge, used individually or in combination with each other. The project, conducted from April 1976 through December 1977 in the Las Vegas, Nevada area, collected data from 435 light-duty fleet vehicles driven in typical highway and urban environments. More than six million test vehicle-miles were accumulated in the course of the project. The test results support the hypothesis stated above. However, the magnitude of the improvements (4 to 6 percent) is less than had been achieved in earlier tests conducted by others (10 to 20 percent). This difference may be attributable to the fact that motivational and performance feedback techniques were deliberately omitted from the test environment. Additionally, smaller improvements in fuel economy also appeared in the untreated control groups, suggesting that driver knowledge of the test and informal information exchange among drivers about fuel-efficient driving techniques may have influenced the results.

55263 (NP—23359) **55 mph fact book.** (National Highway Traffic Safety Administration, Washington, DC (USA)). Sep 1977. 36p. National Highway Traffic Safety Administration, U.S. Dept. of Transportation, Washington, DC.

Initally imposed as a fuel-conservation measure, the 55-mph speed limit has resulted in safety benefits beyond optimistic predictions. some studies indicated that 50% of lives saved each year on the highway since 1973 can be attributed to the speed-limit laws. Recently, the Department of Transportation concluded that 66% of the fatality reduction is attributable to the 55-mph speed limit. No other traffic safety measure thus far implemented has achieved this degree of success in saving lives. Selected facts about the speed limitation are presented in this publication: how the speed limit came about; the relationship between speed and safety; how the driving public is responding to the speed limit; and enforcing the speed limit. Questions most frequently asked by drivers are summarized and responses by the DOT are given. (MCW)

55264 (ORNL/CON—25) **Energy and cost analysis of residential heating systems.** O'Neal, D.L. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 64p. Dep. NTIS, PC A04/MF A01.

Several energy-saving design changes in residential space-heating systems were examined to determine their energy-conservation potential and cost effectiveness. Changes in conventional and advanced systems (such as the gas heat pump) were considered. The energy and cost estimates were developed from current literature, conversations with heating and equipment manufacturers and dealers, and discussions with individuals doing research and testing on residential space-heating equipment. Energy savings as large as 26, 20, 57% were estimated for design changes in conventional gas, oil, and electric space-heating systems, respectively. These changes increased capital cost of the three systems by 27, 16, and 26%, respectively. For advanced gas and electric systems, energy savings up to 45 and 67%, respectively, were calculated. The design changes needed to produce these energy savings increased capital costs 80 and 35%. The energy use and cost relationships developed for the space heating systems were used as input to the ORNL residential energy-use simulation model to evaluate the effect of space-heating improvements on national energy use to the year 2000. Results indicated a large reduction in national energy use if improved conventional and advanced systems were made available to consumers and if consumers minimized life-cycle costs when purchasing these systems.

55265 (TID—28602) **Guide to reducing energy use budget costs. HCP/U60505-01.** (National Association of Counties, Washington, DC (USA); National League of Cities, Washington, DC (USA); US Conference of Mayors, Washington, DC). Apr 1978. 100p. Dep. NTIS, PC A05/MF A01.

As the cost of energy increases, the value of conservation increases equivalently. Easily tapped resources of energy are becoming less available and consequently more expensive. New supplies of fossil fuel are either remote or difficult to extract. Other sources of energy, such as solar or geothermal, are either experimental or in the early stages of commercialization and expensive. Inflation also adds to the woes. This guide gives local elected officials and their staffs the basics of energy conservation, and spells out the "whys," "hows," and "by whoms" that make energy conservation programs work. Color-coded information indicates the "whys" of energy conservation, including the steps that elected officials should take; explains how to initiate energy conservation measures; and gives brief examples of local government efforts in energy management. Detailed information is provided for employee programs, vehicle fleets, new and existing buildings. An extensive bibliography is included. (MCW)

55266 **Energy conservation in the OECD: progress and results.** VanVactor, S.A. (International Energy Agency, Paris). *J. Energy Dev.;* **3**: No. 2, 239-259(Spr 1978).

In the OECD, energy conservation was originally conceived as a means to restore to consumers a measure of control over the oil market. Now, it is aimed at the wise and equitable use of low-cost energy, intended to ease the transition to an economy based on scarcer and more expensive energy supplies. Seven accomplishments listed after a year of energy policy developments in the IEA are: energy conservation is now the cornerstone of U.S. energy policy, Canada has made substantial progress in the last year and, in most areas, will match or exceed the U.S. program. France has developed an extensive program which seems to have produced considerable results. Fourth, in the United Kingdom energy conservation programs have gained momentum and are an important part of the government's policy. Moreover, the Netherlands is in the process of developing a very substantial insulation program, and energy growth has been moderated. Sixth, Japan, while relying to large extent on market prices, has achieved considerable results. Finally Germany, Italy, and Sweden already have programs in place but have initiated general energy policy reviews in which it is anticipated that energy conservation will gain an enhanced status. Detailed analyses from each country are made. (MCW)

55267 **Building for energy conservation.** Burberry, P. New York; Halsted Press (1978). 62p. $10.95.

Ways in which buildings may be designed to increase thermal efficiency are discussed, giving first of all examples of thermal design in relation to climate. How the building itself may be designed to take advantage of solar energy and the ways in which heat loss takes place are described; the effect of design variables such as siting, volume, and insulation is shown. The book also reviews the development of thermal regulations for health and comfort and, more recently, energy conservation. It discusses the possitilities and difficulties of legislation for energy saving. The UK regulations are given in detail together with descriptions of the FHA and ASHRAE recommendations for the USA and the lastest Scandinavian norms. The author argues that no significant cost need be involved in many of the aspects of thermal design, e.g., shape and fenestration; and that these factors should automatically be taken into account by designers. Even existing buildings can be adapted in various respects to save energy consumption. The book concludes with an explanation of calculation methods for U-values, heat loss, plant sizing, seasonal heat requirements, and other procedures, amply illustrated with tables and graphs.

55268 **Energy conservation: the state of the States.** Laughlin, Q.B.Q. Contract EC-77-C-01-8775. Washington, DC; National Governors' Association Center for Policy Research (1978). 34p. $2.00.

The State Energy Conservation Program, established by the Energy Policy and Conservation Act in 1975, has been instrumental in stimulating energy-conservation efforts in all states. This report provides an overview of the energy conservation plans submitted by the fifty states, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the District of Columbia. Included are detailed descriptions of specific initiatives that illustrate the breadth of state program activities. States are now beginning to implement the programs and it is expected that a minimum overall 5% energy-use reduction should be achieved by 1980. State activities under EPCA and subsequently enacted energy conservation programs are evidence of the states' commitment to energy conservation and the role states can play in a national energy program. This report contains information that will be useful to the states in their continuing efforts to develop effective energy conservation programs. The report also will be helpful in the consideration and development of future state energy conservation programs.

55269 **Energy use, energy savings, and cost reductions in all operating departments, City of Lake Charles.** Young, J.C.; Wyman, B.C.; Owen, C.K. Lake Charles, LA; Lake Charles—McNees Urban Observatory (1977). 84p. $5.00.

The project examines the use of electricity, gasoline, oil, and natural gas by the City of Lake Charles. The objectives of studying the city's energy use are to slow the growth of expenditures in this area by providing services more efficiently and thus reducing their energy consumption; purchasing the energy in its least costly form; eliminating unnecessary consumption; and instituting a continuing review of the energy expense the city will require, and either present or anticipated expansion of that service.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 55207, 55209, 55213, 55214, 55244, 55245, 55250, 55277, 55284, 55306, 55363, 55390

55270 (CONF-780201—) **Energy in the Tennessee Valley region.** (Oak Ridge National Lab., TN (USA)). May 1978. Contract W-7405-ENG-26. 186p. Dep. NTIS, PC A09/MF A01.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

A separate abstract was prepared for each of the 14 papers presented at the Plenary Session of the WATTec Conference. George R. Jasney served as the general chairman and opened the Plenary Session with introductory remarks. (MCW)

55271 (NP—23112) **Energy situation and policies in Sweden.** (Ministry of Industry, Stockholm (Sweden). Secretariat for International Affairs). Jul 1977. 10p. Dep. NTIS (US Sales Only), MF A01.

Portions of document are illegible.

Annual consumption of over 50,000 kWh per capita in Sweden is one of the highest in the world. Some 25 to 30 percent of energy demand is met by indigenous sources with the remaining being met by oil and coal imports. Hydroelectric power covers about 12 to 15 percent of total energy supply with nuclear power accounting for 3 percent, wood 9 percent. Exploration for oil and gas have been started in Sweden and on the continental shelf. Dominant consumers of primary energy in Sweden are within the industrial and housing sectors (about 40 percent each) while transportation accounts for 15 percent. The energy policy program is reviewed. The Stipulation Bill has been in force since May 1977. It requires special permits for the introduction of nuclear fuel into reactors. Matters relating to the handling of used nuclear fuel and radioactive waste must be solved before a reactor may be taken into operative use. The workings of the Commission on Energy are described. (MCW)

55272 **Belgium considers new energy sources.** Traill, S. *Energy Int.;* **15**: No. 6, 25-26(Jun 1978).

A new energy policy proposal is expected to emphasize the use of indigenous coal and other energy sources to replace Belgium's heavy reliance on natural gas and oil imports. Efforts to ensure gas supplies by diversifying supply sources were spurred by the dwindling gas fields in Holland and the demands of the Belgian chemical industry. An increase in nuclear energy from the present 25% of electricity generated to an anticipated 50% by 1984 is thought by some to represent too great a dependence on nuclear energy if demand growth continues to fall below expected levels. Expanded use of coal, the major energy source for the steel industry, will require new mining methods and research on gasification.

55273 **British foreign policy to 1985. III. Dependence on non-fuel materials.** Crowson, P. *Int. Affairs;* **54**: No. 1, 48-59(Jan 1978).

Conclusions reached in a longer study entitled "Nonfuel Minerals and Foreign Policy" are summarized here, pointing out the need for integrating foreign and domestic policies with mineral-procurement policies if serious problems are to be avoided in the 1980s. Consideration of the effects of single policy decisions, such as the ban on lead additives to gasoline, could ensure that proper weight is given to specific decisions. The traditional market mechanisms are no longer adequate for the raw material field in which mineral procurement can be affected by cartelization and by supply interruptions for both natural and political reasons. Strategic stockpiles of essential minerals under international control and the mobilization of investments to develop known resources are proposed, although it is recognized that there is no easy solution to price and demand instability.

55274 **Energy and the Third World.** Martin, W.F. (International Energy Agency, Paris); Pinto, F.J.P. *Technol. Rev.;* **80**: No. 7, 48-56(1978).

The imbalance of energy supply and demand is analyzed for ninety-three developing nations, of which 13 are members of the Organization of Petroleum Exporting Countries (OPEC) and 80 are non-OPEC. Estimates of future energy growth by the Workshop on Alternative Energy Strategies (WAES) used the World Bank's SIMLINK model, which assumes a historical relationship between energy consumption and economic growth. Developing countries are projected to have a higher growth rate than developed countries through the year 2000, with the OPEC countries having rates of over seven percent and non-OPEC developing countries rates of four to five percent. Supply and demand estimates are derived for petroleum, natural gas, coal, and electricity for both low and high economic growth. An imbalance emerges that could cause the high-income developing nations to impose constraints on the non-OPEC nations. The most serious constraint would be inadequate capital to develop self-sufficiency. Developing countries may devise policies to moderate energy demand by balancing development equally among the industrial, agricultural, and service sectors. 11 references.

55275 **Energy: where are we headed.** DiBona, C.J. (American Petroleum Inst., Washington, DC). *Proc. Am. Power Conf.;* **39**: 41-48(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The author sums the United States energy situation using six figures to tell the story: (1) 75% of our energy supplies are now derived from oil and gas; (2) we currently depend on foreign suppliers for 45% of our oil supplies, and the trend is upwards; (3) the nation's demand for energy will be 50% greater by 1990; (4) at current production rates, we now have 11 years of proved reserves of oil and of natural gas; (5) pending legislation such as Senate Bill 9—the Outer Continental Shelf Lands Act Amendments—if enacted, could defeat our national energy goals by inhibiting development of domestic energy sources; and (6) zero-risk environmental policies may well add up to zero opportunities for modifying all the other numbers crucial to the nation's future energy welfare. He then presents an energy policy he believes viable on three premises: (a) to bring the demand side of our energy equation under control, conservation is a must; incentives such as market prices that reflect the real value and cost of energy; standards that are flexible enough to optimize energy use in many varying situations; and perhaps other inducements to conserve all our fuels; (b) to reduce our dependence on foreign producers and also to meet our growing needs, we must increase domestic supplies; (c) to permit the growth so vital to the nation's economic welfare, we must redress the balance between environmental concerns and energy needs. At the least, a sound environmental policy, like a viable energy policy, must be based on stringent cost benefit analyses, scientific findings, and the need for flexibility. (MCW)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 54463, 54525, 55030, 55031, 55207, 55218, 55220, 55222, 55228, 55231, 55232, 55233, 55238, 55239, 55241, 55242, 55247, 55249, 55261, 55268, 55270, 55271, 55272, 55273, 55275, 55300, 55397, 55851, 55861

55276 (CONF-780201—, pp 15-34) **Features and objectives of the National Energy Plan.** Bayrer, R. (Dept. of Energy, Washington, DC). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

The National Energy Plan, in terms of limiting energy growth rates and implementing conservation in the future, calls for devoting most of the growth in energy consumption in the U.S. to fueling the needs of industry and increasing our economic output. The plan calls for about a 4 percent growth rate of energy consumption in industry. In the Plan there are a series of proposals to limit the consumption of fuel in transportation through taxes, and to provide economic incentives to use less. The author summarizes some of the basic principles that are fundamental to the proposed plan. First, the growth of energy demand has to be restrained through conservation; this makes sense economically and environmentally, in terms of timing. Secondly, energy prices must reflect true replacement costs. The alternative fuels and energy resources are all going to be more expensive than the fuels being used, particularly the coal, direct burning natural gas, and petroleum. They are not going to be a great deal more expensive if the technologies and the problems involved are understood. In pricing energy then, it makes sense that the consumer realize what the marginal cost of turning to those alternatives is going to be. Consumers should not see a price level that encourages them to overconsume today to the detriment of the future. Producers and consumers are also entitled to more certainty of government policy than they have had in the past, so that they might be in a position to make some of the very large investments that are going to be required as fuel bases are shifted. Finally, the more plentiful resources like coal should be used more widely. And alternative sources of energy should expand, particularly solar energy, within the United States. Then a detailed examination of the industrial, residential, and commercial sectors is presented, particularly, some of the major tax and pricing elements of the National Energy Plan. (MCW)

55277 (CONF-780201—, pp 35-55) **Impact of international energy trends on U.S. energy policy.** Hurlbert, G.C. May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

The author discusses the long-range trends in international energy—the shape of the trends for the remainder of the century. He first sums criteria relating to the growing energy crisis in the U.S. The potential known sources for energy include coal, uranium, solar, and fusion power. After analyzing all the options for the U.S. and of the world, he concludes that conservation plus energy production are major problems confronting the world. Even to meet his conservative energy demand forecast for the rest of the century requires assumptions of conservation, technology, and social acceptance that may not be possible, he says. The impact of the international energy trends on the U.S. energy policy requires our domestic energy policy to encourage, in addition to conservation, rapid progress in

energy-supply development and then develop new energy technologies. New technologies are needed by the free world to reduce energy shortage, the U.S. to reduce need for imported oil, and the U.S. economy to provide an export market. (MCW)

55278 (CONF-780201—, pp 165-167) **Remarks on energy in Tennessee.** Blanton, R. (Governor, State of Tennessee). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

Seemingly with the country going from one crisis to another, Gov. Blanton expressed strongly his feeling that there is no reason for a nation of this caliber going from one crisis to another—given the abundant resources. He urged all persons to support the president in his attempt to formulate an energy policy. The people in the TVA region did cut back 10 percent on energy consumption during the 1977 winter, and the governor feels the populace did learn it can conserve energy. Transportation was emphasized in the brief talk. With Tennessee within 500 miles of 73 percent of the major markets in the U.S., Gov. Blanton would like to re-enervate the railroads and upgrade the whole system. Transportation of hazardous materials must be addressed, he says; various cities in Tennessee had been subjected to spillage of hazardous materials in several recent wrecks or explosions. (MCW)

55279 (CONF-780201—, pp 169-176) **Ethics and energy policy.** Maxey, M.N. (Univ. of Detroit). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

The most important task is suggested to be to ask the right questions (or formulate the problem correctly) before trying to devise answers or solutions to our energy problems. Three different popularized versions are discussed of the problem of energy needs in the U.S.: (1) the cry for "energy independence" since the embargo; (2) the work of the anti-establishment critics; and (3) activities of those who emphasize the moral problem of decadent materialistic values in our society (e.g., 6 percent of the world's people using 35 percent of the world's energy). Pointing out the futility of characterizing the situation with a growth vs. no-growth set of options, it is stated that no knowledgeable person perceives, or argues for, alternative fuels as a condition for maintaining a so-called high-growth, high-consumption society. The point at issue is how to preserve stabilizing continuities in an orderly and speedy replacement. Citing projected nuclear power capacities of various First and Third World countries by the year 2000, it is emphasized that the world is clearly not going to have a nonnuclear future, regardless of the "moral exemplarity" wishfully displayed. To the environmental activist, Dr. Maxey points out that before returning to the "pristine" days of "softer" technology, they should review the situation of just 70 years ago—when disease and health hazards were for worse, and the average life expectancy was 40 to 45 years. The The air pollution produced by mankind does not begin to equal the quantities of toxic gases and particulates from three earthquakes since 1883; and Mother Nature releases ten times more CO to the atmosphere than all the activities of man. In the event of decreasing energy supplies (both in the U.S. and undeveloped countries) it is the poor and underprivileged that suffer first and most.

55280 **Energy minerals.** Goeken, R.J. (Gulf Mineral Resources Co., Denver). pp 6p, Set No. 9, Paper 2 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Based upon the particulars of the National Energy Bill, as passed by the House, the prospects for meeting the overall energy goals set by President Carter are poor. In addition, other pieces of legislation, such as the recent Surface Mine Act, The Clean Air Act amendments of 1977, and the amendments to the Federal Coal Leasing Act, are incompatible with the goals set for increased coal production. Given these impediments , it seems impossible that the national energy goal of 1.2 billion tons-per-year coal production by 1985 can be met. Production of new coal, the keystone of the President's energy production plan, cannot be achieved without some relaxation of overly restrictive standards and regulations. President Carter, in his energy message of April 1977, talked about the need for shortening the nuclear licensing requirements in the U.S. Unfortunately, there has been no government action since that time on how to reduce these requirements. The only decision has been to suspend the development of the Liquid Metal Fast Breeder Reactor and not to proceed with commercial reprocessing and recycling facilities. Delays in mill licensing procedures, constantly shifting safety requirements, changing enrichment policies, and uncertain waste disposal procedures continue to add to uranium development uncertainties. Is there any wonder why electrical utilities have been slow in making new commitments to nuclear power. Problems in proceeding with the recovery of shale oil from oil shales are also discussed. The need for government financial incentives in the further development of the solvent-refined coal process is explained by the size of the investment and the uncertainties involved.

55281 **New age of utility regulation.** Snelling, R.A. (Governor of Vermont). *Public Util. Fortn.;* **102**: No. 3, 11-13(3 Aug 1978).

Based upon address delivered to the 1978 meeting of the New England Public Utility Commissioners in Basin Harbor, Vermont.

Governor Snelling presents a thoughtful view of the changing character and function of public utility regulation. From now on it will not be enough for regulators to regard themselves as mere umpires or protectors of those they regulate, he says. For the sake of obtaining the most-efficient management of public utilities possible, a system of rewards and penalties must be devised—including even the drastic provision of letting very poorly managed utilities fail and be taken over by the more-efficiently managed.

55282 **Alternative cost-of-capital concepts in regulation.** Copeland, B.L. Jr. (Iowa State Commerce Commission, Des Moines). *Land Econ.;* **54**: No. 3, 348-361(Aug 1978).

At the present time two cost-of-capital concepts are more widely used than any other in regulation as a basis for determining the cost-of-equity capital. One of these is the discounted-cash-flow (DCF) concept which is based on a dividend valuation model of common stock prices. The other concept widely used in regulation is the comparable-earnings concept. The economic rationale for comparable earnings as a cost-of-capital concept presumes that investors have the opportunity to invest in direct investment and that the earnings on book value of alternative comparable investment opportunities is therefore properly considered to be the opportunity cost of capital. According to the National Association of Regulatory and Utility Commissioners, more than half of the state commissions presently rely upon or accept comparable earnings as a method of determining the cost of equity for public utilities. Only about one-third of the state commissions have indicated an acceptance of DCF. The paper begins with a review and critique of the comparable-earnings concept as it is applied in regulation, and argues, among other things, that the comparable-earnings approach violates a fundamental marginal condition necessary to achieve efficiency in the allocation of capital, and generally results in an overestimate of the cost of equity. The paper then reviews the corresponding strengths and weaknesses of the DCF approach and suggests that DCF embodies a proper concept of return at the margin that makes it preferable to comparable earnings as a regulatory tool for determining the cost of equity for public utilities. (MCW)

55283 **Energy policy: a consultative document.** London; Her Majesty's Stationery Office (1978). 126p.

This paper considers first the objectives of UK energy policy and means of implementation; then developments in the world energy scene and activities of international organisations. This is followed by consideration of the individual components of the energy sector and their inter-relationship, the effect of conservation on demand trends and the role of each energy industry (coal, oil, gas, electricity and nuclear), R and D strategy, new energy sources, environmental, social, industrial and economic constraints. Finally the reconciling of these factors into shorter and longer term strategies, and decisions required in the coming years are set out.

55284 **Executive energy documents. Printed at the request of Henry M. Jackson, Chairman, Committee on Energy and Natural Resources, United States Senate, Ninety-Fifth Congress, Second Session.** Washington, DC; Committee on Energy and Natural Resources (1978). 438p. GPO.

Over the past 8 years Presidential speeches and messages on energy issues have documented the evolution of energy policy in three administrations. The first Presidential energy message to Congress in 1971 stressed the development of domestic energy resources, with particular emphasis on the development of the fast breeder reactor. Subsequent messages, from both Presidents Nixon and Ford, continued the theme of developing domestic energy resources while proposing various measures to reduce U.S. dependence on oil imports. President Carter's energy messages have emphasized the importance of conservation. The national energy program he submitted to Congress in April, 1977 was designed to achieve conservation through such means as crude oil taxes and reform of utility rate structures. This collection of 57 Presidential energy messages and statements brings up to date similar compilations prepared in 1973 and 1975.

55285 **With the Chancellor's compass figure out of step. Spiegel report on the restlessness and helplessness of the energy policy.** *Spiegel;* **31**: No. 47, 68-79(1977). (In German).

In future one has to distinguish between the time until 1985 when there was primary energy in abundance and subsequent times with limited availability when making forecasts and decisions concerning the energy economy. On the one hand, questions concerning the overall economic growth and the annual increase in electricity

demand will have a decisive effect (the different forecasts for the FRG vary considerably), on the other hand the universal interconnections have to be taken into account when looking at the national supply, e.g. the consumer behaviour of the other partners on the raw material market, in particular the USA and the USSR. The article deals with these worldwide relationships.

55286 Energy policy-making: a selected bibliography. Rycroft, R.W.; Hall, T.A.; Kash, D.E.; White, I.L. Norman, OK; University of Oklahoma Press (1977). 183p. $7.95.

Since the 1973 oil embargo by the Organization of Petroleum Exporting Countries, there has been a trend in the United States toward national energy policymaking, manifested in the creation of new federal energy organizations and the restructuring of already established agencies. There has been a rapid increase in energy-policy research integrating the technical, economic, and environmental components into a public-policy framework. This bibliography presents for the first time the varied results of these endeavors in a format useful to any reader concerned about energy policy, particularly the social scientist and policy analyst. Nothing published before 1970 is included in the bibliography. The latest entries date from May 1977. The range of materials is as wide as possible, including books and articles (both academic and popular), government documents, and dissertations. While U.S. energy policymaking is emphasized, international energy policy research has been sifted and categorized also. An introductory essay defines the bibliographical principles and summarizes the literature in each category. The categories are: Energy Analysis; Energy Decision Making; Energy Economics; Energy Industry; Energy Self-Sufficiency; Energy Use and Conservation; Energy Regulation; Energy Facility Siting; Future Energy Policy; International Energy Policy; Energy and Environment, Health, and Safety; Energy Resources and Technologies; Energy Research, Development, and Demonstration; and Energy Bibliographies.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 55280

COAL

REFER ALSO TO CITATION(S) 54352, 54442, 54502, 54514

55287 (CONF-780201—, pp 75-87) **Environmentally acceptable energy from coal.** Clark, E.L. (Dept. of Energy, Washington, DC). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

In first defining what is environmentally acceptable energy from coal, Mr. Clark showed a slide identifying emission limits for sulfur oxides, nitrogen oxides, and particulates for 1975 and those contemplated for 1980, 1985, and 1995. There are a few options to try to meet these standards—low-sulfur coal; flue-gas desulfurization; combustion (coal-oil mixture, fluidized bed, direct substitution); liquefaction (H-coal, EDS, SRC); and gasification (high Btu and low Btu). Each of the options are then discussed in detail and slides were used to depict Mr. Clark's explanations on each of the subjects. (MCW)

55288 (CONF-780201—, pp 117-123) **Coal prospects in the Tennessee Valley.** Foster, H. (National Coal Association, Washington, DC). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

Herbert Foster predicts that Appalachian coal will be the propelling force in the southeastern economy for years to come. Use of atomic energy in the region will continue and increase, he believes. TVA is the largest consumer of coal in the United States. Coal industry's chief concern is not finding customers, but finding ways to satisfy them. That involves in a great many cases either getting government out of the way or getting answers to a lot of unsolved problems that involve government. The government laid out a proposal that coal production should increase by 400 million tons a year by 1985, but the program has never been written into law. The fact is that while government is still struggling to write the legislation into law, the forces of the marketplace have propelled coal production upward. The author cites the counterproductivity of some legislation that did pass—a rigid surface-mining bill and the Clean Air Act. With regulations that are workable and environmental goals that are attainable without shutting the country down, Mr. Foster says the National Energy Plan will become a reality. (MCW)

55289 (ORNL/TM—6073) **Survey of industrial coal conversion equipment capabilities: heat recovery and utilization.** Gambill, W.R.; Reed, W.R. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 137p. Dep. NTIS, PC A07/MF A01.

A scoping survey of the capabilities of industrial heat recovery equipment was conducted to determine their adaptability to proposed coal-conversion complexes. Major categories of heat exchangers included shell-and-tube, periodic-flow and rotary regenerators, heat pipe arrays, direct phase contactors, and steam and organic Rankine cycles for power generation from waste heat. Primary applications encompassed feed-effluent and other process stream interchangers, combustion air preheaters, and heat recovery steam generators (waste heat boiler-superheaters). It is concluded that the single area providing the greatest potential for extending US industrial heat-recovery equipment capabilities as related to coal-conversion processes is a research, development, and testing program to acquire more physical-property and heat-transfer data and more-reliable design correlations.

55290 Western coal: promise or problem. Tyner, W.E.; Kalter, R.J. Lexington, MA; Lexington Books (1978). 194p.

Although western coal may allow the United States to meet the constraints imposed by the Clean Air Act while increasing coal consumption, the decision to resume leasing publicly owned coal raises a host of unresolved problems about both the approach and pace to be followed. In-depth analysis of alternative policies is urgently needed to provide information for the public and its decision makers. Consequently, the disposal of coal lands in the public domain is the chief focus of this study. The study is divided into two major parts. The first deals with micro or leasehold aspects of coal leasing--ownership patterns, logical mining units, leasing policies, end uses of coal (and their impacts on fair market value), and intertract competition. The second part evaluates macro or leasing schedule aspects of western coal development--the pace and location of leasing, as dictated by demand (magnitude and location), transportation economics, geology, and production economics (by mining area). Both portions of the analysis emphasize western surface-mining possibilities, because near-term economic conditions appear to favor their development over underground situations. Policy recommendations for improving the efficiency of coal development activity is the principal objective of the study. Implications of various schedules and policies for production profiles, production location, and present-value economic results provide the focus. What emerges is a picture of how western coal located in the public domain can be expected to augment future domestic supply under various market conditions and management policies.

55291 Tripartite energy consultations. London; Her Majesty's Stationery Office (1976). 30p. (NP—23291). £ 1.00 net.

This paper is a transcript of the coal/electricity tripartite consultations held February 20, 1976 at Church House, Westminster. The discussion centered on the energy gap forecast for the 1990s. The chairman, Mr. Tony Benn, stressed in his opening remarks the need to obtain a sensible integrated energy policy. (MCW)

PETROLEUM

REFER ALSO TO CITATION(S) 54564, 54571, 54573, 54574

55292 Middle East oil and gas policy. Taher, A.H. (Governor, General Petroleum and Mineral Organization, Saudi Arabia). *J. Energy Dev.;* 3: No. 2, 260-269(Spr 1978).

Current total proven oil and gas reserves in the Middle East, located mostly in Saudi Arabia, Iran, Kuwait, Iraq, the United Arab Emirates, Qatar, and Oman, are estimated at 367.3 billion barrels of oil and 16 trillion cubic meters of gas. These figures represent, respectively, about 67% of the total free world's proven oil reserves and 41% of its total gas reserves. Saudi Arabia's oil reserves, estimated at over 151 billion barrels, are the largest in any single country. International economic and political implications related to Middle East oil and gas policy since the end of WWII are examined. The major motivating factors contributing towards evolution of oil and gas policy in the Middle East include: (a) the producing countries' fundamental desire to gain effective national control over their oil and gas resources; (b) diversification of the sources of their national incomes; (c) development of integrated national oil and gas enterprises with special emphasis on development of a national marketing capability to serve both the domestic and the international oil and gas markets; (d) increased processing of petroleum in the producing countries; (e) increased national participation in the international energy-transportation industry; (f) augmentation of current oil and gas reserves and production capacities; (g) conservation of depleting oil and gas resources; and (h) development of alternative sources of energy and international cooperation, with special emphasis on assistance to and protection of developing countries' interests in the field of energy. These factors are used to discuss policy implications in Saudi Arabia. (MCW)

55293 Determinants of long-term demand for OPEC oil. Al-Janabi, A. (Organization of the Petroleum Exporting Countries, Vienna). *J. Energy Dev.;* 3: No. 2, 347-365(Spr 1978).

The debate on the factors influencing demand for crude oil and the role of crude oil prices in influencing the level of total demand is in need of reevaluation in the light of recent experiences. Despite the wealth of material on the subject, much of it is of limited value when it comes to analysing present events and predicting future behavior. The aim of this paper is to demonstrate the flaws in recent analyses of the industry, and suggest an alternative framework of analysis. As far as long-term demand for OPEC oil is concerned, it is found that OPEC oil acts as a residual supplier. All alternative sources of energy operate at near capacity; non-OPEC oil producers also operate at near operational capacity. Therefore, long-term demand for OPEC oil is determined more by the physical constraints on all other energy supplies than by any other single element. The most significant physical limitations on non-OPEC energy supplies are determined by policies of consumer governments rather than by OPEC's crude oil-pricing policies. Price increases which do not imperil general economic activity would have little effect on demand for OPEC oil in the short and medium term. In the long term, price increases are necessary to reduce demand for OPEC oil to expected export levels. Such price increases have to come in the short and medium term to have the desired long-term effect.

55294 Storage of petroleum products in unlined caverns. Jansson, G. (AB Skanska Cementgjuteriet, Stockholm). *Underground Space;* 2: No. 1, 27-37(Sep 1977).

A storage installation comprising unlined rock caverns has certain advantages compared to an installation above ground. Maintenance costs are ⅓ of those to be expected for steel cisterns above ground. The product temperature is more even, breathing losses decrease. The risk of fire or other difficulties associated with leakage and accidental discharge of product are less. The amenities of a countryside are not destroyed by bulky cisterns above ground. Storage of strategic reserves underground gives much better protection against both attack and observation. An oil storage depot with cisterns above ground may often fully occupy the site and there may be difficulty in acquiring further land. If the site is based on rock the installation may be complemented by a rock storage installation and the receiving and distribution facilities already in use can serve the extra capacity. Apart from gas storage underground there has as yet been little underground storage of other petroleum products except in Scandinavia. There are, however, many other places where underground storage should offer a realistic alternative. The general principles governing storage are first described with reference to the storage of products such as light fuel oil that are of low viscosity and non-explosive at normal temperatures. The modifications necessary for storage of petrol, crude oil, LP-gas, and high-viscosity oils are then treated.

55295 Petroleum and the economy of the United Arab Emirates. Al-Otaiba, M.S. London; Croom Helm Ltd. (1977). 290p. $55.00.

The discovery of oil in the United Arab Emirates transformed a simple and primitive community into a rapidly-developing and prosperous new society. The petroleum industry has promoted the development of subsidiary and service industries alongside the traditional ones and has heralded the emergence of a new era of economic interdependence between the United Arab Emirates and the Arab world as a whole. This study analyzes the major aspects of the petroleum industry and its effects upon the economy of the UAE. It looks firstly at the country's physical features, population, and economic structure. It then considers the history and legal framework of the industry, the oil companies operating within the country, and the UAE's relations with the world oil community. A third section deals with the evolution of the National Product, consumption and banking, and monetary regulations together with the economic development of the country. Economic integration on both a regional and pan-Arab scale is also discussed. A final section looks at the future of the petroleum industry and attempts to forecast likely changes in the industry and the future of the UAE's relations with the oil companies.

55296 Arab oil weapon. Paust, J.J.; Blaustein, A.P. Dobbs Ferry, NY; Oceana Publications, Inc. (1977). 377p. $27.50.

This compilation of publications dealing with the Arab oil weapon presents documents and commentaries. In Part I, the Embargo, fhe documents include: Historical Chronologies; The United States Oil Shortage and the Arab-Israelic Conflict; OPEC: Oil Negotations, OPEC, and the Stability of Supply; and OPEC Resolutions and Other Documents. Commentaries include: The Arab Oil Weapon--A Threat to International Peace, by Jordon J. Paust and Albert P. Blaustein; Destination Embargo of Arab Oil: Its Legality Under International Law, by Ibrahim F. I. Shihata; The Arab Oil Weapon: A Reply and Re-Affirmation of Illegality, by Jordan J. Paust and Albert P. Blaustein; Economic Coercion and the International Legal Order, by Richard B. Lillich; Some Politico-Legal Aspects of Resource Scarcity, by Timothy Stanley; and OPEC in the Context of the Global Power Equation, by Jahangir Amuzegar. Part II, The Response, includes the following documents: Presidential Statements: Carter and Ford; The Energy Crisis: Strategy for Cooperative Action, by Henry A. Kissinger; Oil Fields as Military Objectives; and Data and Analysis: Concerning the Possibility of a U.S. Food Embargo as a Response to the present Arab Oil Boycott. The commentaries in Part II are: Oil: The Issue of American Intervention, by Robert W. Tucker; War--The Ultimate Antitrust Actions, by Andrew Tobias; and The Need for Negotiated Reforms, by John H. Jackson. Part III, Legal Framework, contains 10 United Nations documents and 4 treaties. (MCW)

NATURAL GAS

REFER ALSO TO CITATION(S) 54630, 55292

55297 (CONF-780201—, pp 125-147) **Natural gas prospects for the Tennessee Valley region.** Thomas, R.C. (Tennessee Gas Transmission Co., Houston, TX). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

Mr. Thomas first presented an overview, with the aid of slides, of the natural gas situation over the total United States. Then, the natural gas situation for Tennessee, Kentucky, Alabama, and Mississippi was depicted. Tenneco, Southern Natural, United Energy, Texas Gas Transmission, Columbia Gas, and Chandeleur Pipe Line provided the majority of supplies to the 4 states. Projections are made for gas consumption to 1982 in the area. Plans for supplemental supplies to be brought to the region include importation of natural gas from Mexico, LNG from Algeria, gas from Alaska, and synthetic natural gas from coal. Mr. Thomas concludes that even though coal production, nuclear power generation, and domestic oil supplies increase, the volume of imported oil is going to continue to grow. (MCW)

55298 (DOE/FERC—0009) **National gas survey: report to the Federal Energy Regulatory Commission by the Conservation-Technical Advisory Task Force on Efficiency in the Use of Gas.** (Department of Energy, Washington, DC (USA); Federal Energy Regulatory Commission, Washington, DC (USA)). Jun 1978. 132p. Dep. NTIS, PC A07/MF A01.

As the available supplies of natural gas diminish, it is imperative that existing supplies of gas be utilized in the most prudent manner. The most important stimulus to promote the wise use of gas is the price of gas itself. The inevitable rising prices of natural gas will continue to enhance the cost-effectiveness of many natural gas conservation strategies. It is widely recognized that there are significant opportunities to reduce the wasteful and inefficient use of gas and that some of the most cost-effective conservation strategies are being applied only locally or regionally. This paper identifies and analyzes methods that promote the efficient use of and conservation of natural gas. To assist in the evaluation of the methods, the relative cost of implementing each strategy and the impact on gas usage were identified. The Task Force has identified 25 energy-conservation strategies that may be useful to the homeowner. Solar-assisted gas hot-water heating is reviewed. In the near future, solar hot-water heating with natural gas as a backup may prove to be economically viable. Many of the strategies that may benefit the residential sector can be directly applied to many small commercial and industrial customers. Individual metering of tenants of a commercial building makes each user cognizant of his consumption. A methodology for identifying potential energy savings in commercial buildings is presented in Appendix C. Large commercial and industrial consumers often have unique process requirements for gas and no generalized approaches are available. Moreover, most of these consumers have the in-house technical expertise to identify gas-saving measures on a case-by-case basis. Appendix D provides a guide to energy conservation for industrial consumers. Incentives for implementing energy conservation are discussed in detail. (MCW)

55299 (UCRL—52498) **Overview of recent trends in California natural gas consumption (1975—1977).** Borg, I.Y.; Anderson, C.J.; Sextro, R.; Rubin, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jun 1978. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

The recent decline in natural gas consumption in California was documented, and possible explanations for it were examined. Decreases in the residential and commerical sectors seem to be due to changes in consumer behavior rather than to hardware modifications. The decline in interruptible industrial use seems to be due to fuel switching, loss of customers in this category, and industrial conservation. Drops in the amount of gas used for electric power generation account for much of the total decrease in the state since 1972. However, the relatively mild winters of 1976-77 and 1977-78 led to a reversal in this trend. The decreased demand led to temporary gas surpluses, which were used for electric power generation.

55300 Gas price issue. Eckhardt, B. (House of Representatives, Washington, DC). *J. Energy Dev.;* 3: No. 2, 270-276(Spr 1978).

In the fall of 1977, five sets of conferees from the Senate and a single set from the House of Representatives met numerous times to discuss and negotiate issues dealing with a national energy policy. Nothing had been settled on natural gas pricing when President Carter called a meeting of the conferees shortly before Christmas, 1977. The House had already offered one compromise proposal to the Senate modifying its bill in a conciliatory direction. The Senate conferees had divided nine to nine on the House's proposal. If the stalemate were to be broken, compromise was necessary, and to fail quickly to formulate an outline of possible agreement might well result in a loss of the momentum toward a national energy policy. At least on the part of the President and the House conferees' majority, three objectives were salient: (1) whatever the gas-pricing mechanism, it should not significantly raise aggregate consumer costs above those projected under the existing program; (2) there must be elimination of the differential between intrastate and interstate prices of gas which forces gas to less-essential uses and causes shortages in the interstate market; and (3) price certainty must be obtained so that exploration not be delayed to a better day. The author summarizes the legislative activities in the eight-month interim between the introduction of the Carter program and the called White House meeting. Whatever the final outcome he believes the three objectives above should control resolution of the issue. (MCW)

55301 Industrial utilization of natural gas of various origins. Sommers, H.; Joos, L. (Ruhrgas A.G., Essen (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **31**: No. 2, 88(Feb 1978). (In German).

55302 Moving natural gas from Alaska: Arctic Gas is the best choice. Murphy, M.J. Minneapolis; Upper Midwest Council (1977). 14p. $1.00.

The Federal Power Commission, the Congress, and the Executive Branch have studied and debated three alternative proposals for moving natural gas from the Arctic region to the contiguous 48 states; (1) Arctic Gas—a route across Alaska, through western Canada and into the west and midwest regions of the U.S.; (2) El Paso—a route across Alaska and via tankers to southern California; (3) Alcan—across Alaska and through western Canada (but carrying only U.S. gas). The purpose of the Council's study of this topic is to give consideration to the net effect any of the three alternative proposals has on the Upper Midwest and the nation as a whole. This effort is designed to summarize (for purposes of comparison) the key factors of the three proposed systems in terms of how well it will serve the region's energy picture and that of the nation, too. The Arctic Gas proposal is recommended as the system that provides the best overall benefits to consumers in the Upper Midwest and throughout the nation. In this situation, the interests of the region and of the nation are substantially the same. Clearly, the objective for the nation, for all regions and for all individuals is to pursue and implement that system which provides the most economical, efficient, environmentally sound and firm, long-term supply alternative. The Arctic Gas proposal fulfills those requirements better than the other two competing systems. This paper is an updated version of one entitled "Transporting Arctic-Region Natural Gas to the 48 States," issued August 5, 1976.

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 54758, 54769

ELECTRIC POWER

REFER ALSO TO CITATION(S) 55234, 55235, 55291

55303 (CONF-780201—, pp 89-99) **Utility rate reform: good intentions on the way to enactment.** Wishart, R.S. Jr. (Union Carbide Corp., New York). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

Many proposals have surfaced for utility rate reform as a result of rising utility bills for homes, offices, and industry. A brief review of some of the proposals shows that one claims to make it easier for the poor and the elderly to pay their utility bills; some aim to cut costs by spreading the use of power plants over more hours of the day; others hope to reduce the number of power plants needed in the future. Some are designed to make users of electricity and gas pay all the costs of supplying them, even speculative estimates of social and environmental costs included, in an effort to send up the kind of price signals that will make you think twice before using additional amounts. And still others propose to reduce energy bills for some segments of the population by shifting part of the cost to someone else. The question surrounding most of the proposals is not whether or not the announced goals are desirable; most of them seem to be. The real question is, "Will these proposals actually accomplish the desirable goals or are they ideas whose good intensions are lost on the way to enactment." The opportunity is needed to separate fact from myth. The author concludes that there are great areas of uncertainty in all rate-reform proposals. He discusses in detail the area of misinformation in the utility rate field—and the underpinning of many current rate proposals—that the residential customer subsidizes the industrial customer and that home electric bills would go down if all customers paid their fair share. (MCW)

55304 (CONF-780201—, pp 107-115) **Electric energy: the future is now.** Wagner, A.J. (Tennessee Valley Authority, Knoxville). May 1978.

From Wattec - Public Awareness Symposium; Knoxville, TN, USA (25 Feb 1978).

In Energy in the Tennessee Valley region.

The demand for coal will increase due to a continued population growth and an inevitable shift from oil and gas to electricity. TVA's system supplied 118 million kilowatt hours of electric power in 1976, and is estimated to go to 210 million kWh by 1986. The author lists four factors that will tend to reduce consumption of electricity, but the demand will grow. The question remains how will the demand be met. In the TVA area, there are hydro plants, nuclear plants, and coal-fired plants. Mr Wagner discusses the importance of nuclear plants and the legal barriers to be overcome. The goal in the energy business is to provide all of the energy that the people honestly need—at prices they can afford—without unacceptably altering the environment, he concludes.

55305 (DOE/ET—0051) **Electric energy network: cross matching and integrating energy sources and uses.** (Department of Energy, Washington, DC (USA). Div. of Electric Energy Systems). Jul 1978. 15p. Dep. NTIS, PC A02/MF A01.

The U.S. electric energy network is vast, complex, and multifaceted. It is a major part of the total energy picture, and thus its continued successful operation is critical to the future economic health and social well-being of this country. To meet the challenges and opportunities, DOE's Division of Electrical Energy Systems (EES) developed a broadly based R, D and D program in associated technologies and in systems development and control, addressing both near-term and longer-range needs. The EES Division has a somewhat special character within DOE in that it cuts across organizational boundaries and ties together the various electric energy technologies from generation, through transmission and distribution, to customer end uses. The principal elements of the EES program are: power delivery (advanced generator and transformer technology, high voltage direct current (HVDC) technology, compact lines and stations, advanced underground cable systems, and electric field effects); and power supply integration (dispersed generation, dispersed storage, load management and distribution automation and control, complex systems control, and large-scale systems development). The broad objective of this program is to insure that the national electric energy system is capable of meeting future demands reliably, with lowest practicable energy losses, at the lowest possible cost, and in accordance with environmental and NEP principles and policies.

55306 (EMD—78-76) **Region at the crossroads: the Pacific Northwest searches for new sources of electric energy.** (General Accounting Office, Washington, DC (USA)). 10 Aug 1978. 262p. U.S. General Accounting Office, P.O. Box 1020, Washington, DC.

In the Pacific Northwest region most large hydroelectric sites have been developed; additional large hydropower supplies are no longer available. Yet power demand will no doubt continue to rise as the population expands and new industrial growth occurs. Coal-fired and nuclear power plants are being advocated; conservation options and potentials for geothermal energy, solar radiation, and secondary solar energy forms, such as wood wastes, wind, and small-hydro developments are proposed. Regional institutions are struggling to develop new electricity-management policies that can reconcile future energy needs with the environment and economy. The region's traditional decision-making processes are ill-equipped to deal with the problems of transition. No single Federal, state, or local organization is responsible for regionwide electricity management. In the absence of strong and unified leadership, energy-management objectives have not been established and regional institutions are in conflict over forecasting methods, conservation potentials, future energy sources, and power planning practices. Conflicts have also developed over customers' rights to Federal hydropower and utility requests for Federal assistance in financing new power plants. This report discusses options for the Pacific Northwest electric energy needs through the year 2000 and the Bonneville Power Administration's role in meeting those needs.

55307 (EPRI-EA—837) **Initiation of integration. Final report.** Baughman, M.L.; Cazalet, E.G.; Hudson, E.A.; Jorgenson, D.W.; Kresge, D.T.; Kuh, E.; North, D.W. (Texas Univ., Austin (USA); Data Resources, Inc., Cambridge, MA (USA); National Bureau of Economic Research, Inc., Washington, DC (USA)). Jul 1978. 153p. Dep. NTIS, PC A08/MF A01.

This report explores alternative methods of bringing together research findings from EPRI's Energy Analysis and Environmental (EA and E) Division in a manner designed to meet the needs of the research user. A panel of consultants recommends an iterative, problem-directed strategy as the most effective one for this purpose. The emphasis in this strategy is on assembling information to meet a specific client need, using whatever analytical tools are required for the specific problem, rather than on building comprehensive long-term models for more general use. To demonstrate the effectiveness of the recommended approach, four new Systems Programs projects are proposed: EPRI Cycling and Peaking R and D Planning--An Application of Integrated Forecasting for R and D Planning; Over- Versus Underplanning of Electric System Capacity; Integrated Regional Electric Power and R and D Analysis; and Industry and Economic Impacts of Restrictions on the Growth in Electric Power. Each of these projects will be designed to deliver a package of supply, demand, and environmental information tailored to the particular needs of EA and E research clients. These clients are identified in the report as EPRI planning staff, advisory groups, and management: the electric utility industry; and the public and governmental groups concerned with energy policy.

55308 (NP—23269) **Draft environmental impact report: load management standards.** (California Energy Resources Conservation and Development Commission, Sacramento (USA)). 22 Mar 1978. 302p. Energy Resources Conservation and Developmenta Commission, Sacramento, CA.

The Draft EIR has been prepared in accordance with the California Environmental Quality Act, and contains an analysis of the proposed load management standards. The project is in response to Public Resources Code requirements and consists of four proposed regulations. The regulations are to be applied to the State's five largest utilities: Pacific Gas and Electric, Sacramento Municipal Utility District, Southern California Edison, Los Angeles Department of Water and Power, and San Diego Gas and Electric. The four regulations are: residential load switching, swimming pool filter pumps, conservation surveys, and load-management tariffs. The Load Management Standards could have certain socio-economic and environmental ramifications. Impacts to electric consumers arise from changes in electric rates, appliance usage patterns, and time-of-day electric use. Additional impacts occur as utility systems adjust to changes in consumption patterns. (MCW)

55309 **State determinations of the need for power.** Hemphill, J.B.; Salomon, S.N. *Public Util. Fortn.;* **102**: No. 3, 25-29(3 Aug 1978).

A lawyer and an economist, both oriented toward the environmental sciences, report on findings of a comprehensive survey of procedures and criteria used by state governments for making decisions on the need for additional power supply in connection with proposed electric power generation facilities. The study was commissioned by the Nuclear Regulatory Commission and conducted by the Center for Natural Areas in Washington, D.C. The regulatory commission's interest stemmed from its responsibility under existing law to determine that the benefits of a proposed nuclear power generating station outweigh its environmental costs and the possibility that procedures might be authorized and developed permitting that obligation to be discharged by carefully supervised state determinations of need for power.

55310 **Path towards the sensible use of electricity.** Voelker, A. (Berliner Kraft- und Licht (BEWAG)-A.G. (Germany, F.R.)). *Elektrowaerme Int., Ed. A;* **36**: No. 1, 25-27(Jan 1978). (In German).

The debate on energy problems has occasionally been marked by an emotional rather than an objective approach. Expertise and balanced view-points will therefore have to dominate the scene again to put things into proper perspective. In the past electricity has made a vital contribution to the growth of productivity. It has helped to improve working conditions and brought better comfort and advances to the community in general. Competition with other forms of energy made it necessary for electricity to be used efficiently. The future aim will be to further developments towards the sensible and purposeful use of electricity. Perfectionism and opportunism are out of place.

55311 **System load forecasts for an electric utility.** Uri, N.D. (Federal Energy Administration, Washington, DC). *Energy Sources;* **3**: No. 3/4, 313-322(1978).

This paper discusses forecasting hourly system load for an electric utility using Box-Jenkins time-series analysis. The results indicate that a model based on the method of Box and Jenkins, given its simplicity, gives excellent results over the forecast horizon.

55312 **Interfaces between educators and the power industry.** Hicks, L.F. (Ohio Univ., Athens). *Proc. Am. Power Conf.;* **39**: 49-53(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Project Probe, sponsored by the American Electric Power System and begun in the summer of 1956, initially consisted of one professor and 12 students. The students probed new ideas and new ways of doing things at power plants. The twelve-week course was run each summer from its inception until 1969. Then, AEP decided to run a similar program for its own engineers. This activity was labelled PIP—Performance Improvement Program—and is described briefly. (MCW)

55313 **What engineering graduates did not learn in school.** Kolflat, T.D.; Aschoff, A.F. (Sargent and Lundy, Chicago). *Proc. Am. Power Conf.;* **39**: 54-60(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

The knowledge needs of the mechanical engineers at Sargent and Lundy, Chicago, are summarized. This includes the design of power plants and their associated structures, transmission lines, and construction management services. Personnel need be trained in thermodynamics, fluid flow, heat transfer, power plant heat cycles, power plant equipment, and an acquaintance with the complementary engineering disciplines. The company performed a survey of their own young mechanical engineers—who had been with them for at least two years—to get their views on what was required and what was lacking in engineering education. The author sums the views and then presents his views on what the educational capabilities of our universities should be. (MCW)

55314 **Energy education for the future.** Miley, G.H. (Univ. of Illinois, Urbana). *Proc. Am. Power Conf.;* **39**: 61-64(1977). (CONF-770403—).

From 39. annual meeting of the American Power Conference; Chicago, IL, USA (18 Apr 1977).

Two curricula of importance to power engineering at present are: traditional electrical power and nuclear engineering. The power field changed very slowly up to the present decade, but suddenly the energy crisis and environmental issues—combined with governmental regulation—have created tremendous stresses. The educator and industry must decide how best to respond to the situation. One temptation is to insert courses in the curriculum to cover all directions. The opposite extreme would be to include one or two survey courses to provide a broad coverage. The author feels that survey courses seldom provide the type of insight necessary, suggesting that students should be expected to pick up general coverage on their own. The author analyzes the university's dilemma to conclude that a series of generalized basic (as opposed to survey) courses is needed. He sees the energy crisis both as a challenge and an opportunity, requiring an intense industry-university effort. (MCW)

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 54506, 54507

55315 **African rivers hold promise of major energy supply.** Eskillson, E. *Energy Int.;* **15**: No. 7, 19-21(Jul 1978).

Completion of a group of hydroelectric projects in southern Africa will provide a source of renewable energy to the area and could result in a subcontinental power grid. A project planned for the Orange River, South Africa's largest water system, will eventually include nine dams, 20 power stations, tunnels, and a system of irrigation canals. Projects for the Cunene River (which forms the Angolan-Namibian border), the Zambesi, Kafue, Zaire, and Great Ruaha Rivers are all described in terms of construction status and total planned generating capacity.

55316 **Germany looks at pumped-storage options.** Lottes, G. *Energy Int.;* **15**: No. 7, 30-32(Jul 1978).

With most hydroelectric sites already developed, Germany is studying the feasibility of pumped-storage power stations to see if they can meet changes in the daily load curves and structural changes in system costs and where suitable sites are located. Improvements in turbine, pump, and generator construction have raised the efficiency of pumped-storage plants from 60 to near 80 percent. The author covers the design and operation of mechanical and electrical equipment in modern pumped-storage facilities. Economic feasibility of the stations is expected to favor nuclear power or brown-coal-fired plants for the pumping energy. Changes in penstock design, switchgear stations, and building design make pumped-storage plants less objectionable than formerly, although reservoirs must be carefully engineered to avoid being eyesores when the water levels are lowered.

55317 **Coal conversion defines route for gas-turbine development.** Jenkins, N.; Swiss, M. *Energy Int.;* **15**: No. 6, 33-35(Jun 1978).

The 1978 Gas Turbine Conference and exhibition was held in London against a background of a stagnant US utility market and a buoyant European industry taking orders from the Middle East. However, the prospect of coal-derived fuels in the future is keeping US development plans alive. There is interest in getting higher efficiency through combined-cycle developments and the installation of more modern engine types on oil and gas pipelines.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

55318 BPA proving UHV transmission is economical and acceptable. Parks, G.A.; Lee, J.M.; Perry, D.E. *Electr. Light Power (Boston);* **56**: No. 7, 36, 39(Jul 1978).

The Bonneville Power Administration (BPA) is using the Lyons Test Facility to develop ultra-high voltage (UHV) transmission lines that will have lower power losses and require less land than lines of comparable capacity. The test center experiences the same weather conditions as the BPA service area and crosses both wooded and agricultural areas to allow biological as well as electrical testing. Several performance aspects are tested, including corona measurement, ground level electric field effects, and line hardware. Preliminary testing has produced data on audible noise, conductor movement, and various animal and plant responses. Future tests will examine the effects of higher ground level field strengths on plants during the growing season and on economic studies.

55319 High voltage overhead. Miller, M.W. (Univ. of Rochester, NY); Kaufman, G.E. *Environment;* **20**: No. 1, 6-15, 32-36(1978).

Neither animal and plant experimentation nor clinical studies nor 25 years experience with operating EHV transmission lines have to-date provided convincing evidence for a harmful effect of exposure to electric and magnetic fields associated with transmission lines, in spite of numerous attempts to find such effects. Likewise, on a biophysical basis one would have no reason to expect there to be effects. The overwhelming body of scientific evidence indicates that electric and magnetic fields associated with high-voltage transmission lines have no deleterious biological effects. Current plans for future higher-voltage transmission lines appear to limit maximum ground-level electric fields to approximately the 10 kV/m level. Above about 10-12 kV/m the possibility of "annoyance" shocks becomes greater. Also, above 15 kV/m some people may find the skin sensation annoying. Therefore, while there does not appear to be any serious risk from the direct biological effects of electric or magnetic fields generated by future transmission lines operating at higher voltages, if future designs call for gradients much in excess of 10 kV/m it is suggested that a serious risk-benefit assessment should be undertaken. Subjects specifically discussed are environmental impacts, biophysical considerations, biological investigations, fish and birds, electric shock, Soviet standards, and cardiac pacemakers. (MCW)

55320 Perspectives of electric power consumption in the Federal Republic of Germany. Hecking, W. *Rundbrief;* No. 3, 13-14(1977). (In German).

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 55221, 55225, 55248, 55262, 55263, 55269

55321 Institutional factors affecting EV usage: excerpts of a special report prepared for the DOE. *Electr. Veh. News;* **7**: No. 2, 10-14(May 1978).

A study is presented giving an analysis of such institutional biases and their influence on U.S. surface transportation systems toward vehicles of particular characteristics. Its primary focus is on biases for or against electric and hybrid vehicles as compared with conventional ICE vehicles. To perform the analysis, an analytical structure and methodology were developed to define and evaluate institutional factors and their potential impact on particular vehicle characteristics.

UNCONVENTIONAL SOURCES AND POWER GENERATION

SOLAR

REFER ALSO TO CITATION(S) 54821, 54823, 54824, 54826, 54845

55322 1979 Department of Energy authorization (advanced energy technologies and energy conservation). Volume V. Hearings before the Committee on Science and Technology, U.S. House of Representatives, Ninety-Fifth Congress, second session. Washington, DC; Committee on Science and Technology (1978). 1132p. GPO.

The Subcommittee On Advanced Energy Technologies and Energy Conservation R, D, and D reviewed the administration's 1979 budget for the above DOE programs. On Jan. 26, 1978 the budget on solar electric energy production was investigated. On Jan. 30, the conservation budget of the DOE involving all sectors was examined. Materials on new concepts, impact assessments, data analysis, and regulations are presented. On Feb. 1, testimony was given concerning the organization and role of the new Office of Energy Research within DOE. After reviewing these issues, John M. Deutch reported on the Solar Energy Research Institute and the regional centers. On Feb. 2, the increased (23%) geothermal program budget testimony included information on fund allocation, program emphasis, and the loan guarantee program. To continue an examination of the $1 billion energy conservation budget, the Feb. 3 hearing involved electric energy systems, energy storage systems, conservation research and technology, district-heating implementation, and utility insulation services. On Feb. 6, Mr. George Lawrence presented the American Gas Association's analysis of the DOE budget for 1979 and offered recommendations; also, Mr. William H. Podolny presented views from United Technologies Corp. on fuel-cell power plants and combustion gas turbines; and finally, Professor Simpson Linke from Cornell commented on development of alternative energy storage technologies. In the overall collection here, statements by experts in all fields are included. (MCW)

55323 1978 ERDA Authorization (solar-geothermal). Hearings before the Subcommittee on Advanced Energy Technologies and Energy Conservation Research, Development, and Demonstration of the Committee on Science and Technology. U.S. House of Representatives, Ninety-Fifth Congress, First Session, February 24, 25; March 1, 3, 1977. No. 37, Volume I. Washington, DC; Committee on Science and Technology (1977). 530p. GPO.

At the initial Subcommittee hearing on February 24, 1977 on the 1978 ERDA Authorization (Solar-Geothermal), Honorable Mike McCormack presided. He first reviewed legislation on solar energy to date and the role it will play in providing energy supplies of the total energy mix in the U.S. Statements were presented by Drs. Robert L. Hirsch and Henry M. Marvin. On February 25, 1977, Honorable Ray Thornton presided, and following his opening statement, Dr. Hirsch again presented a statement. At the March 1, 1977 hearing, Honorable Mike McCormack presided, and the statements dealt with geothermal energy. The statement of Donald A. Beattie was followed by one by Dr. James C. Bresee. Continuing and completing the series of hearings on the ERDA Budget Authorization legislation, Representative George E. Brown, presided. Statements were heard from Dr. William Brown, Dr. Myron Dorfman, and Mr. Wallace Brand on geothermal energy. (MCW)

GEOTHERMAL

REFER ALSO TO CITATION(S) 54865, 55322, 55323

OTHER

REFER ALSO TO CITATION(S) 54798, 54802, 54815, 54895

ENERGY CONVERSION

MHD GENERATORS

55324 (CONF-780595—3) **Overview of liquid-metal MHD.** Dunn, P.F. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 21p. Dep. NTIS, PC A02/MF A01.

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

The basic features of the two-phase liquid-metal MHD energy conversion under development at Argonne National Laboratory are presented. The results of system studies on the Rankine-cycle and the open-cycle coal-fired cycle options are discussed. The liquid-metal MHD experimental facilities are described in addition to the system's major components, the generator, mixer and nozzle-separator-diffuser.

55325 Prospects for more effective utilization of fuel through MHD. Ovcharenko, V.A. *Nat. Resour. Forum;* **1**: No. 1, vp(Oct 1976).

The magnetohydrodynamic method of power generation is a direct method for the conversion of thermal energy into electricity. The basic features of this method are outlined and its potential for reducing fuel consumption is highlighted. The prospects for and the

principal problems associated with the wider application of MHD are explored. Specific points examined include the impact of MHD on pollution, the main technical and economic parameters, the current status of MHD technology, and recent international cooperation in this field.

DESIGN AND DEVELOPMENT

55326 (FE—2341-6) **High magnetic field MHD generator program. Quarterly report, January 1978—March 1978.** Eustis, R.H.; Kruger, C.H.; Mitchner, M.; Self, S.A.; Koester, J.K. (Stanford Univ., CA (USA)). Apr 1978. Contract EX-76-C-01-2341. 18p. Dep. NTIS, PC A02/MF A01.

During this past quarter the High Temperature Gasdynamics Laboratory MHD test facility has been under modification to provide space for the 7 tesla superconducting magnet to be furnished by the Department of Energy. Therefore only "bench top" experiments were run and data reduction from previous experiments and analyses were continued. The test section for the next fluctuation experiment was completed and will be installed in the magnet as soon as the facility modifications permit. To improve agreement between the experimental results and theoretical predictions of electrode wall parameters, roughness was added to the boundary layer model and it was found that the electron number density non-equilibrium was overpredicted if the usual electron recombination coefficient was used. Sections of the disk generator assembly were redesigned to provide for better thermal characteristics and instrumentation access.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 55327

MATERIALS, COMPONENTS, AND AUXILIARIES

55327 (FE—2246-5) **Testing and evaluation of MHD materials and substructures. Quarterly technical progress report, July, August, September 1977.** Murphree, D.L.; Bell, C.J.; Cain, R.W.; Nail, J.B.; Powe R.E.; Shepard, W.S.; Wehr, A.G. (Mississippi State Univ., Mississippi State (USA). Energy Research Center). Oct 1977. Contract EX-76-C-01-2246. 43p. Dep. NTIS, PC A03/MF A01.

The objective of this work is to simulate the gas-slag-seed conditions that will exist in various substructures of the coal-fired baseline MHD power plant and evaluate the performance of the substructures. The initial tests will attempt to characterize as closely as possible the ambient conditions that will exist in the radiant boiler of the baseline MHD plant. Information will be obtained on the chemistry of the gas stream and slag deposits at selected points representing radiant boiler locations and the regenerative air heater inlet. A primary objective of this phase of the contract is to provide preliminary engineering data to assist in the design of engineering tests of subscale prototype air heaters and of slag/seed recovery systems. The tests will also provide information for materials selection for the radiant boiler. Following this phase, attention may be turned to corrosion studies of superheater components if sufficient experimental data are available to define the conditions of superheater operation. Progress is described on the following tasks: (1) testing and evaluation of metallic components under static conditions; (2) testing and evaluation of metallic components under dynamic conditions; and (3) technical support for the national MHD program.

55328 (FE—6010-1) **Development, testing, and evaluation of MHD-materials. Quarterly report, January—March 1977.** Frederikse, H.P.R.; Negas, T.; Schneider, S.J. (National Bureau of Standards, Washington, DC (USA). Inst. for Materials Research). 31 Mar 1977. Contract EA-77-A-01-6010-035. 48p. Dep. NTIS, PC A03/MF A01.

Efforts during this reporting period were directed primarily toward the design, fabrication, testing and pre- and post-test evaluation of real MHD electrode materials. Close collaboration was maintained with a number of MHD contractors and subcontractors with respect to procurement of specialized materials and their design. Additionally, NBS is involved with a number of MHD tests including the accelerated program of electrode testing in the MIT rig, the U-02 experiments, the AVCO tests utilizing slag and the UTSI/USSR tests. The evaluation/characterization of electrodes/insulators from five tests were completed and final reports were submitted. Several preheater refractories were also analyzed for Fluidyne Engineering Corp. Progress in other areas included: (1) Viscosities of synthetic slags based on analyses of USSR coal ("Krushnitz") and "average" Montana Rosebud and Illinois No. 6 were measured. (2) The electrical conductivity of several oxide spinels was measured. (3) New measurements involving K-pressure over K_2O-SiO_2 solutions and a crystalline potassium zirconate were completed. (4) Chemical reactions in the K_2O-Al_2O_3-SiO_2-FeO/sub x/ system were investigated. (5) Mg-Al-Fe-oxide spinels were evaluated in terms of bonding to a metal substrate. Important chemical aspects of these oxides are discussed. (6) Evaluation of alloys for downstream components continued.

55329 **Magnetohydrodynamic electrode.** Merchant, D.D.; Killpatrick, D.H. (to Dept. of Energy). US Patent Application 773,360. 1 Mar 1977. 14p.

An electrode capable of withstanding high temperatures and suitable for use as a current collector in the channel of a magnetohydrodynamic (MHD) generator consists of a sintered powdered metal base portion, the upper surface of the base being coated with a first layer of nickel aluminide, an intermediate layer of a mixture of nickel aluminide-refractory ceramic on the first layer and a third or outer layer of a refractory ceramic material on the intermediate layer. The sintered powdered metal base resists spalling by the ceramic coatings and permits greater electrode compliance to thermal shock. The density of the powdered metal base can be varied to allow optimization of the thermal conductivity of the electrode and prevent excess heat loss from the channel.

DUCT ENGINEERING AND FLUID DYNAMICS

REFER ALSO TO CITATION(S) 55326

THERMOELECTRIC GENERATORS

MATERIALS, COMPONENTS, AND AUXILIARIES

55330 (GA-A—14969) **Suppression of vaporization in copper—silver-selenide thermoelectric materials.** Chin, J.; Elsner, N.B. (General Atomic Co., San Diego, CA (USA)). Jun 1978. Contract EY-76-C-03-0167-060. 17p. (CONF-780801—20). Dep. NTIS, PC A02/MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Current thermoelectric generator designs using P-type $(Cu,Ag)_2Se$ specify hot cap temperatures of 850 to 1000°C for target generator efficiencies. Vapor pressures of volatile species above this material are high even at 850°C. Thus the only way these designs can be made feasible is to develop a vapor suppression system which will inhibit $(Cu,Ag)_2Se$ degradation and weight loss. Suppression of vaporization in P-type copper—silver-selenide $(Cu,Ag)_2Se$, was attempted by applying coatings and by mechanical barriers. The difficulties encountered with this material are associated with its very high thermal expansion and change in stoichiometry. Coatings which were both chemically inert and reactive with selenium were examined and include both crystalline and glassy coatings. Vaporization rates for inert and glassy coatings were $^1/_5$ the rates of uncoated control samples. Reactive coatings reduced 850°C isothermal weight loss rates to $^1/_{10}$ that of uncoated controls. Theoretical and experimental studies have been preformed on bonded elements containing both glass sleeves and coatings. Results obtained with this concept have shown the greatest promise for minimizing 900°C vaporization degradation.

THERMIONIC CONVERTERS

DESIGN AND DEVELOPMENT

55331 (COO—3056-32) **NASA/DOE advanced thermionic technology program. Progress report No. 30.** (Thermo Electron Corp., Waltham, MA (USA)). Dec 1977. Contract EY-76-C-02-3056. 21p. (TE—4233/4237-90-78). Dep. NTIS, PC A02/MF A01.

Experimental measurements and computer calculations of I-V curves and electron temperatures for thermionic converters are presented and discussed. Brief summaries on the construction and testing of several experimental thermionic converters are given. (WHK)

FUEL CELLS

REFER ALSO TO CITATION(S) 54506, 54507

DESIGN AND DEVELOPMENT

55332 **Electric power plant using electrolytic cell-fuel cell combination.** Morrow, W.E. Jr.; Hsu, M.S.S. (to Massachusetts Inst. of Tech.). US Patent 4,087,976. 9 May 1978. Filed date 13 Aug 1976. 12p.

High-temperature (1200 to 1500°K) electrolysis of water and recombination of the products in a medium-temperature (530°K) fuel cell achieve a practical efficiency exceeding 50%. A solid electrolyte is chosen for the electrolytic cell and in combination with the Bacon fuel cell, which offers high efficiency and automatic replenishing of

water vapor into the cycle realizes a high-efficiency electrochemical cycle. Both high-temperature, gas-cooled reactors and conventional combustion processes may be used as heat sources. Unconventional heat sources, such as concentrated solar energy, can also be used. A regenerative counterflow heat exchanger and a waste-heat power plant serve as energy-conserving devices. An important feature of this cycle is the flexibility of operation that can be achieved by adding hydrogen storage. Switching among power-generating, load-averaging, and hydrogen-generating modes can then be done by simple gas-flow valves.

55333 Fuel cell power generating stations. Nadler, M.; Cahn, R.P. (to Exxon Research and Engineering Co.). US Patent 4,080,791. 28 Mar 1978. Filed date 3 Jan 1977. 6p.

An integrated power generating plant includes a fuel cell for generating electrical energy directly and an auxiliary power generating plant that utilizes both the sensible heat and the heating value of effluents from the fuel cell by using working fluids in a closed cycle. The working fluid is vaporized by sensible heat and is superheated by combusting incompletely reacted fuels from the fuel cell.

55334 Secondary fuel cell. Haas, R.J.; Briggs, D.C. (to Ford Aerospace and Communications Corp.). US Patent 4,074,018. 14 Feb 1978. Filed date 4 May 1977. 54p.

This application discloses a secondary fuel cell having improved electrode zones. Each cell has two electrode zones each containing a pair of electrode structures. A first such electrode structure in each zone is more efficient in operation during discharge of the fuel cell. Electrical structure is provided so that the first electrode structures are utilized during charging of the fuel cell and the second electrode structures are utilized during discharge of the fuel cell. The size and configuration of each of the electrode structures is a variable depending upon the particular cycle the fuel cell is to be subjected to in operation.

55335 Energy conversion. Zito, R. (to GEL, Inc.). US Patent 4,069,371. 17 Jan 1978. Filed date 10 May 1976. 26p.

An instantly refuelable energy conversion system is described comprising a multicell array wherein each cell has a cathode, a solid anode fuel selected from the class consisting of iron, zinc and nickel and a ferric (and/or +3 valence nickel or zinc) chloride liquid oxidizer. In power delivery (discharging) e.g., using iron alone, the reactions are: At the anode, $Fe \rightarrow Fe^{2+} + 2e$ yielding 0.44 volts. At the cathode, $Fe^{3+} + e \rightarrow Fe^{2+}$ yielding 0.75 volts, the overall reaction being: $Fe + 2FeCl_3 \rightarrow 3FeCl_2$, i.e., 1.2 volts overall. These reactions are reversible for electrical charging purposes. The oxidizer is recirculated continuously and chemical reaction between the oxidizer and solid fuel in the fully charged or partially charged system is limited by a diffusion barrier between the oxidizer and fuel so that reactions therebetween are predominantly electrochemical. The system is characterized by continuously countering the tendency of rising pH of anolyte, and/or of contaminant accumulation therein, to maintain stable operation over long periods, e.g., by using a main energy conversion system anolyte as a catholyte in an auxiliary, overdriven energy conversion system which at the same time the catholyte of the main system serves as anolyte of the auxiliary system with reliance on the richness of the liquid in hydrogen ion and Fe^{3+} ion to chemically attack any elemental iron formed in the auxiliary system thereby further preserving stability. The iron may be substituted in whole or in part by zinc and/or nickel.

MATERIALS, COMPONENTS, AND AUXILIARIES

55336 (AD-A—050920) Definition of chemical and electrochemical properties of a fuel cell electrolyte. Interim technical report 25 mar 77-24 dec 77. Sarada, T.; McIntyre, J.F.; Foley, R.T. (American Univ., Washington, DC). Feb 1978. Contract DAAK70-77-C-0080. 46p. NTIS PC A03/MF A01.

The present research is oriented toward the task of developing an improved electrolyte for the hydrocarbon-air fuel cell. A literature study of the properties of organic acids indicated that the following types of compounds warranted further investigation: Aromatic poly carboxylic acids - partially neutralized perfluoroaliphatic carboxylic acids, Mono, di and poly sulfonic acids and substituted sulfonic acids. This was followed by an experimental program wherein the vapor pressure, wetting characteristics, electrical conductivity, chemical stability, and electrochemical stability were measured.

55337 Water separation cell for removing the reaction water from the electrolyte of fuel cells and fuel cell batteries. Grave, B.; Gutbier, H.; Deinzer, M. (to Siemens Aktiengesellschaft). US Patent 4,085,255. 18 Apr 1978. Priority date 12 Mar 1976, German, Federal Republic of (F.R. Germany). 4p.

A water separation cell for removing the reaction water from the electrolyte of fuel cells and fuel cell batteries is described. The system comprises a liquid chamber bounded on at least one side by a porous diaphragm, and a gas chamber bounded by the diaphragm and a condensation surface adapted for cooling, in which the liquid chamber is subdivided into two chambers of different size which are arranged on top of each other with the upper, larger chamber serving as the electrolyte space and the lower, smaller chamber taking up the condensate which passes through the porous diaphragm into this chamber due to the pressure of a gas present in the gas chamber.

55338 Fuel cell matrix and method of impregnating periphery of matrix with chlorotrifluoro-ethylene polymer. Baker, B.S.; Ng, D.Y.C. (to Consolidated Natural Gas Service Co., Inc.). US Patent 3,533,852. 13 Oct 1970. Filed date 28 Dec 1966. 6p.

Fiberglass or asbestos matrix elements for liquid electrolyte fuel cells are edge-impregnated with solutions of CTFE or copolymers of CTFE with VF_2 dissolved in a suitable solvent, such as MEK. The method of impregnating includes dipping and drying of the matrix several times and increased concentrations of the solution may be used in the second or subsequent immersions. It is disclosed that the impregnated edge must be compressible, but less so than the non-impregnated portions of the matrix. The preferred impregnant is Kel-F, and the resultant matrix shows improved leak resistance and batteries containing the matrix elements show improved operation.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

55339 (USIP—77-35) Energy conservation in literature. Report to the World Energy Conference, Energy Conservation Commission. Andersson, K. (Stockholm Univ. (Sweden). Institutionen foer Teoretisk Fysik). Dec 1977. 112p. Dep. NTIS (US Sales Only), PC A06/MF A01.

A survey of estimations made concerning the potential for energy conservation and the measures proposed for realizing this potential is given. An analysis of methods and results concerning different aspects of energy conservation is followed by some recommendations for the future development of the "science" of energy conservation. The need for a systemwide approach towards energy conservation, more information about the environmental and social aspects of energy conservation, and more work concerning the thermodynamics of energy conservation is emphasized. Appendices containing a large number of references are included.

55340 Energy conservation - wish and reality. Schaefer, H. *VDI (Ver. Dtsch. Ing.) Ber.;* No. 282, 13-18(1977). (In German).

From Meeting on the application of energy at the final consumption stage - analysis, planning, techniques; Schliersee, Germany, F.R. (17 - 18 May 1977).

Illustrated by several examples from practice, it is explained how difficult it is to tell in connection with complex technical systems, whether small specific investments will lead to relieving the overall energy balance. The dangers are overestimations, e.g., energy conservation by introducing summer time as well as against wrong interpretations, e.g., the assessment of the driving energy of passenger cars are discussed.

55341 Relationship between energy conservation, GNP, and energy consumption. Penner, S.S.; Bernard, J.M. *Indian East. Eng.;* No. 119, 83-85(1977).

Evolving concepts on the relation between energy use and economic well being are summarized, and results are presented of recent studies on energy conservation which suggest that improved process efficiency is preferable to shifting end use. Finally, the economic feasibility and environmental impacts of wildland biomass and agricultural waste utilization as a fuel resource are discussed. (LCL)

BUILDINGS

REFER ALSO TO CITATION(S) 55208, 55227, 55261, 55267, 55298

55342 (AD-A—048982) The building loads analysis and system thermo-dynamics (BLAST) program. Volume II. Reference manual. Final report. Hittle, D.C. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Dec 1977. 437p. (CERL-TR-E—119-Vol-2). NTIS PC A19/MF A01.

The Building Loads Analysis and System Thermodynamics (BLAST) program is a sophisticated set of subprograms for predicting energy consumption in buildings. The four major subprograms are: the input processor, which parses the high-level input language and sets up the building/systems/plant descriptions; the building loads subprogram, which computes the hourly space load in a

building or zone based on the user's description of the building/zone and hourly weather data; the air distribution system simulation subprogram, which calculates the coil energy demands, fan power, etc., based on the user's description of the air handling system and the hourly space load data calculated by the previous subprogram; and the central energy plant simulation subprogram, which calculates energy consumption of a central/solar/total energy plant based on the user's description of the plant and the hourly coil loads calculated by the previous subprogram, and performs a life-cycle cost analysis of the plant. In addition to conventional boiler-chiller equipment, the central energy plant subprogram includes solar heating and cooling systems, total energy systems, and commercial utility systems. The program is written in Control Data Corporation (CDC) FORTRAN Extended, Version 4, and can be used on CDC 6000/7000 series computers without major modifications. This volume is the reference manual for BLAST and contains descriptions of all BLAST subprograms, as well as structural algorithm charts where appropriate.

55343 (AD-A—049276) **Air leakage measurements in navy housing in Norfolk, Virginia. Final report.** Lagus, P.L. (Systems, Science and Software, La Jolla, CA (USA)). May 1977. Contract N62583-77-M-R178. 40p. (SSS-R—77-3179). NTIS PC A03/MF A01.

Air leakage measurements by the tracer dilution technique were conducted in two separate three-bedroom apartments in the Willoughby Bay housing area, Norfolk Navy Base, Norfolk, VA. Sulfur hexafluoride was used as the tracer gas, and the gas concentration was measured with a portable electron capture gas chromatograph at 10-minute intervals during two-hour test periods to determine dilution rates. Air change rates were determined directly from the logarithmic dilution rate of the tracer gas. The procedures used were documented in detail for possible incorporation into a field measurement procedure that is being developed at the Civil Engineering Laboratory.

55344 (COO—4490-3) **Use of fluidized bed heat exchangers in heat pump systems for improved performance. Technical status report, March 1, 1978—May 31, 1978.** Chen, J.C.; London, E.J.; Sarubbi, R.G. (Lehigh Univ., Bethlehem, PA (USA)). May 1978. Contract EC-77-S-02-4490. 15p. Dep. NTIS, PC A02/MF A01.

Construction of the test facility including plenum and ductwork has been completed and the heat pump has been operated. In the interest of maintaining comparable test conditions a single compressor with switchover capability between the fluidized bed and the existing heat exchangers is to be used. A computer program simulation of the York heat pump gives results for COP which are too high. Heat transfer measurements for the design of the fluidized bed heat exchangers using a bare tube show an increase in heat transfer coefficient of about five times for air velocity of 0.5 meters per second using spherical glass beads 245 microns in diameter.

55345 (LBL-W—7822) **Air infiltration in buildings: literature survey and proposed research agenda.** Ross, H.; Grimsrud, D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1978. Contract W-7405-ENG-48. 198p. Dep. NTIS, MF A01.

Portions of document are illegible.

Air infiltration, the uncontrolled leakage of air through cracks and openings in a building envelope, contributes significantly to energy consumption required to maintain an acceptable environment within a building. Field studies have revealed that infiltration may represent between 20 to 50% of the building's heating load. Analysis of the infiltration phenomena has been attempted extensively over the last 30 years. The literature published as a result of these studies is surveyed and summarized. The need for accurate analytical modeling of infiltration is emphasized. Finally, the following research projects of immediate interest are proposed: establishment of a centralized data management center; design and conduct of tracer gas measurement in a large commercial building; model infiltration for the building using the Tamura-Shaw algorithm and others that may be of interest; measurements to correlate pressurization leakage ratio with infiltration in selected residences; and open window infiltration measurements and determination of occupant motivation for opening of windows. (LCL)

55346 **Method and system utilizing steam turbine and heat pump.** Manning, J.I. US Patent 4,093,868. 6 Jun 1978. Filed date 29 Apr 1974. 6p.

Discharge cooling water from the condenser of a steam turbine is pumped through the chiller of a refrigeration machine operating as a "heat pump" during heating duty, thus improving the efficiency from that obtained when using water supplied to the chiller at a lower temperature. Evaporation of the refrigerant in the chiller removes heat from the water supplied thereto, whereby the water temperature is closer to that of the source from which it is taken for use in the turbine condenser.

55347 **VAV: a realistic look at fan energy costs.** Lack, C. (Flakt Ltd., Staines, Eng.). *Heat. Vent. Eng.;* **52**: No. 609, 23-24(Jun 1978).

An appraisal is given of variable air volume (VAV) fans with respect to fan selection and degree of cost savings in initial and running costs. Power consumption data and payback period estimates are presented, and it is concluded that fan design selection should not be based solely on the primary cost. (PMA)

55348 **Heat pump as seen from the aspect of the gas industry.** Striebeck, P. (Rhenag Rheinische Energie A.G., Koeln (Germany, F.R.)). *Gas- Wasserfach, Gas-Erdgas;* **119**: No. 2, 87-91(Feb 1978). (In German).

For rational energy applications the technology of heat pumps can be used for space heating. Electricity and gas utilities are making efforts to use the compression heat pump economically in detached houses and small blocks of flats. Both types of plant, the gas heat pump inherently and the electrically driven heat pump due to its bivalent alternative method of operation with gas as additional energy carrier, have effects on the profits made in the gas industry. The article tries to point out the economic problems arising for the gas business of supply undertakings from heat pump technology and to show general solutions to the problems.

55349 **Transient method for measuring thermal properties of soils.** Abdel-Wahed, R.M.; Pfender, E.; Eckert, E.R.G. (Minnesota Univ., Minneapolis (USA). Heat Transfer Lab.). *Waerme- Stoffuebertrag.;* **11**: No. 1, 1-8(1978).

In connection with energy conservation studies by subsurface construction, thermal properties of soils are needed for a wide range of temperature and moisture levels. Because of several disadvantages of steady state methods, a transient method has been developed which requires substantially less time than steady state tests, reduces the problem of moisture migration, and provides simultaneously thermal conductivities and thermal diffusivities. The design of the apparatus and the test procedure are discussed. The agreement of sample results with steady state measurements assures reliability of the equipment which will be used for generating a wide spectrum of thermal soil data.

55350 **To what extent can district heating help to solve the energy crisis.** Triboulet, A. *Entropie;* **14**: No. 80, 3-11(1978). (In French).

District heating can save energy through combined production, and it can burn coal. This is on the condition that the unit dimensions of the systems are adequate, and that they are installed in areas of sufficient density, i.e., approximately 4,000 inhabitants per square kilometer. About forty systems in provincial cities and extensive irrigation of the Paris conurbation would result in a saving of $^1/_2$% of the primary energy consumed by the country, and burn 3,500,000 tons of coal a year. The cost would be about 30,000 million francs. This should not be taken as a deterrent, and the subject is worth thorough profitability studies and optimizations. The fact remains that general values which at least show how weak elasticities are must be kept in mind.

55351 **Report on the programme study prepared for the German Ministry for Research and Technology on heat distribution.** Finck, P. *Three R Int.;* **16**: No. 10, 587-591(Oct 1977). (In German).

The consumption of primary energy and the burden on the environment can be substantially reduced if increased use is made of district heating. Various studies carried out for the German Ministry for Research and Technology have shown the benefits to be derived from a comprehensive supply of district heat in conurbations. The cost of piping and of the distribution networks are the decisive factors for the economy of district heating systems. The programme study is intended to furnish ideas for research and development efforts aimed at reducing cost and improving pipe laying techniques. For establishing these R and D programmes the present state of the art in West Germany and in countries with an advanced technology in the supply of district heat was investigated. Altogether 76 pipe laying methods were recorded and classified. Based on an assessment of these methods, and their weaknesses and on knowledge gained in allied branches, a total of 45 research and development programmes with different priorities was worked out. An analysis of the development potentialities led to recommendations for research in eight areas.

55352 **Supply of heat over considerable distances using large-diameter pipes.** Eisenhauer, G. (Kraftanlagen A.G., Heidelberg (Germany, F.R.)). *Three R Int.;* **16**: No. 10, 591-597(Oct 1977). (In German).

District heating can make a substantial contribution to the efficient utilization of energy. The increasing use of power generating plant as a source of heat and the utilization of secondary heat from heat/power stations and industrial processes has led to a development where large quantities of heat will have to be conveyed over considerable distances. The article reports on the present state of the art and discusses recent developments and problems in the engineering and construction of major pipelines designed for this purpose. Routing, design criteria, laying techniques and economy are discussed along with the findings of the initial feasibility studies.

55353 Engineering and construction of the Ruhr district heating supply line. Hannes, K. (STEAG A.G., Essen (Germany, F.R.)). *Three R Int.;* **16**: No. 10, 598-602(Oct 1977). (In German).

Steag AG is at present engaged in building a demonstration plant for the Ruhr district heating supply line in the centre of the Ruhr area with funds furnished by the Federal Ministry for Research and Technology. The author first deals with the question as to why the increasing scarcity of energy will make it necessary to resort to district heating. The project described represents the first attempt at testing a system that interconnects district heating systems in connurbations and which can be connected to major power stations and sources of industrial waste heat. Owing to the numerous supply mains and sewers in the area, the expansion of the district heating supply line encountered considerable difficulties. These were overcome and the major portion of the Ruhr district heating grid has been completed to schedule.

55354 District heating lines in Warsaw. Fink, P. *Three R Int.;* **16**: No. 10, 602-605(Oct 1977). (In German).

Major cities in the People's Republic of Poland have extensive district heating networks. Of a total of 3000 km of district heating lines, 900 km are installed in Warsaw where 113 million m^3 of enclosed space out of a total of 125 million m^3 are supplied with district heat. Construction of the Warsaw district heating network began 25 years ago. The heat is mainly produced in heat/power stations. The largest pipe used in Warsaw for the supply of district heat has a nominal diameter of 1200 mm. The two-line system is employed almost exclusively. Hot water is predominantly used as heat-carrying fluid. Conduits of precast concrete elements are most widely used for laying such pipes. Other methods similar to those employed in Western Europe and plastic jacket pipes have also been used but with mostly poor results. It should be noted that the river Vistula is crossed by two district heating lines of 700 and 900 mm ID. It is intended to continue development work on laying methods to make these more efficient.

55355 Asbestos cement jacket thermally insulated with PUR foam plastic - properties and applications. Gerke-Reineke, L. (Gesellschaft fuer Asbestzement-Erzeugnisse m.b.H. und Co. K.G., Herne (Germany, F.R.)). *Three R Int.;* **16**: No. 10, 605-610(Oct 1977). (In German).

AZ jacket pipes insulated with PUR foam plastic have been used in district heating grids for eight years. No system failure has as yet been recorded. The article discusses the properties of the system and the requirements to be met by district heating mains and shows that the AZ jacket pipe represents an attractive alternative to the conventional method in which the line is run through conduits as it combines their favourable properties with those of the buried pipe systems using no conduits. This opens new possibilities for the forthcoming expansion in the supply of district heat.

55356 Consideration of economic factors when examining the efficiency of district heat supply plants. Gahrmann, A. (Fichtner, Beratende Ingenieure fuer Energie- und Waermewirtschaft G.m.b.H. und Co. K.G., Stuttgart (Germany, F.R.)). *Three R Int.;* **16**: No. 10, 618-623(Oct 1977). (In German).

When extending district heat supply plants economic aspects will have to be much more considered than when extending other heat supply systems. In this connexion it proves that the effects on employment and tax yield must be compared. Of course, the high capital costs of district heat guarantee a certain insensibility to price increases of the current costs, but they can also impede the execution of other, possibly more profitable private or publitic measures and the development and change to new, may-be more economic heat systems. To receive quantative statements, it is proposed to mark out certain minimum standards with respect to protection of the environment, energy savings etc. and to choose the most profitable of the remaining possible solutions. Combinations of different heat systems are also admitted. The standard of comparison shall be the actual value of all arising costs. For the mathematical solution, the method of Linear Programming is proposed. With the aid of this method, measures for particular periods of time and special areas can be determined in detail, so as a total optimum can be obtained. This mathematical system enables moreover to determine the costs of opportunity or restrictions. Thus for example the yield of governmental investment assistances for the extension of district heat supply could be determined.

55357 Continued development of the vacuum steel jacket pipe system in the supply of district heat. Tautz, A. (Fernwaermeversorgung Niederrhein G.m.b.H., Dinslaken (Germany, F.R.)). *Three R Int.;* **16**: No. 10, 611-618(Oct 1977). (In German).

The experience gained in almost 15 years with more than 92 km of two-line mains of steel jacket pipes has shown that this innovative system has proved successful. Owing to its advantages such as small space requirements, high strength, ease of monitoring, low heat losses, it can be expected to be more widely adopted, especially since costs could be appreciably reduced by rationalization, prefabrication, reduction of civil engineering work and, more recently, of expansion joints. The steel jacket pipe system can be expected to become increasingly attractive for the further expansion of district heating, particularly for long-distance lines involving little heat loss.

55358 Ideas on the growth of district heating. Matthoefer, H. (Bundesministerium fuer Forschung und Technologie, Bonn-Bad Godesberg (Germany, F.R.)). *Three R Int.;* **16**: No. 10, 585-586(Oct 1977). (In German).

The heat demand and production of waste heat in the FRG are estimated in the introduction. The results from the Federal Ministry of Research and Technology's supported study on district heating as well as the problems and outsets for further development of district heat supply are discussed.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 55191, 55264

55359 (BNL—24568) Comprehensive areal model of residential heating demands: data and methods, BNL. Tessmer, R.G. Jr. (Brookhaven National Lab., Upton, NY (USA)). [nd]. Contract EY-76-C-02-0016. 5p. (CONF-781005—1). Dep. NTIS, PC A02/MF A01.

From 2. symposium on systems and decision sciences; Berkeley, CA, USA (2 Oct 1978).

Data sources and methodology for modeling annual residential heating demands are described. A small areal basis was chosen, census tract and minor civil division, to permit estimation of demand densities and economic evaluation of community district-heating systems. The demand model was specified for the entire nation in order to permit validation against other published fuel-consumption estimates for 1970. A demand projection model was developed to permit comparison of district-heating with conventional-heating systems in future years. NOTE: this document is only a lengthy abstract of the paper presented at the symposium.

55360 (EPRI-EA—793(Vol.1)) Load and use characteristics of electric heat pumps in single-family residences. Final report. Blake, P.J.; Gernert, W.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). Jun 1978. 178p. Dep. NTIS, PC A09/MF A01.

Field tests were designed to record heat pump and total house electric energy usage every 15 min usingmagnetic tape recording equipment. A total of 120 existing installations in 12 different geographic regions was instrumented. The aims of the study were to: measure heat pump heating system and component performance factors; determine the electric power input and energy use characteristics as a function of: climate, house size and type of construction, occupants, internal loads, heat pump model and size; compare heat pump and electric furnace heating systems with respect to total energy use, maximum electric power demand and time-of-day profiles; compile data during the project which relate to the maintenance and reliability of the heat pumps under test; and collect and format data for future use with computer programs simulating building energy dyamics. The following conclusions were made from various anslyses of the data: average seasonal performance factors for the tested heat pump systems could be related to degree days heating; about 15% of the calculated SPFs were within +-10% of a predicted ideal SPF, some 25% were within 15% of the predicted ideal SPF; heat pump heating systems should save considerable energy relative to electric furnaces over the wide range of degree days heating encompassed by this test; group heat pump system electrical demand and group total electrical demand peaked in the afternoon during cooling months and in the morning during heating months; group heat pump system demands show a higher coincidence factor than group total house demand indicating that a common factor among the houses (outdoor temperature) tends to make the heating system demands move together; and not counting the periodic maintenance calls, there were approximately 1.3 service calls per heat pump year with those requiring service averaging about two repairs each.

55361 (EPRI-EA—793(Vol.2)) Load and use characteristics of electric heat pumps in single-family residences. Final report. Blake, P.J.; Gernert, W.C. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). Jun 1978. 176p. Dep. NTIS, PC A09/MF A01.

The field tests were designed to record heat pump and total house electric energy usage every 15 minutes using magnetic tape recording equipment. A total of 120 existing installations in 12 different geographic regions was instrumented. The aims of the study were to: (1) measure heat pump heating system and component performance factors; (2) determine the electric power input and energy use characteristics as a function of climate, house size and type of construction, occupants, internal loads, heat pump model and size; (3) compare heat pump and electric furnace heating systems

with respect to total energy use, maximum electric power demand and time-of-day profiles; (4) compile data during the project which relate to the maintenance and reliability of the heat pumps under test; and (5) collect and format data for future use with computer programs simulating building energy dynamics.

55362 (HCP/W2843—01) **Minnesota retrofit insulation in situ test program.** (Minnesota Energy Agency, St. Paul (USA); Dynatech R/D Co., Cambridge, MA (USA); Weidt (John) Associates, Inc., Minneapolis, MN (USA)). Jun 1978. Contract EY-76-C-02-2843. 131p. Dep. NTIS, PC A07/MF A01.

The use of cellulose, glass fiber, rock/slag fiber and urea formaldehyde installed as retrofit insulation materials in residential walls and ceilings was studied. Homes were selected for testing according to the type of retrofit insulation, age of retrofit insulation and whether the retrofit was in the wall or ceiling. The total project was comprised of 22 wall and 48 ceiling samples. Samples of retrofit insulation were taken from an area of three to four square feet in the ceiling or wall of the home. The sample volume was measured, the sample removed and double-sealed in polyethylene bags. The samples were shipped to the laboratory for testing. Laboratory measurements were made of density, moisture content, thermal resistance, and relative flammability of each sample. Additionally, the friability and compressive strength of each urea-formaldehyde foam sample was measured. The following results were obtained. Cellulosic loose fill insulation tests indicated that settling and moisture build-up are not serious problems. Flammability is a concern. Age did not affect the properties of the cellulosic loose fill, but fungal growth was evident. Shrinkage, ranging from 2.5 to 9 percent, averaging 4.5 percent, was exhibited. Degradation of the foam samples with time did not occur. Density was the most critical property affecting the other properties. The higher the density, the higher the thermal resistence per inch, the lower the friability and the higher the compressive strength. The accurate prediction of the fiber diameter, amount of unfiberized mineral, and extent of modular clumping thermal resistance of loose fill mineral fiber insulations is related to and is not solely a factor of density. The materials in this sample did not noticeably affect the structure or wiring of the retrofitted homes. (LCL)

55363 (ORNL/CON—24) **ORNL engineering-economic model of residential energy use.** Hirst, E.; Carney, J. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 86p. Dep. NTIS, PC A05/MF A01.

The ORNL residential energy use model was developed to simulate energy use in the residential sector from 1970 through 2000. The model provides considerable detail on annual energy uses by fuel, end use, and housing type; and also estimates annual equipment installations and ownership, equipment energy requirements, structure thermal performance, fuel expenditures, equipment costs, and costs for improving thermal performance of new and existing housing units. Thus, the model provides considerable detail on residential energy uses and associated costs. These details are useful for evaluating alternative energy-conservation policies, programs, and technologies for their energy and economic effects during the next quarter century. The present version of the model deals with four fuels, eight end uses and three housing types. Each of these fuel use components is calculated each year as a function of stocks of occupied housing units and new construction, average housing size, equipment ownership by fuel and end use, thermal performance of housing units, average unit energy requirements for each equipment type, and usage factors that reflect household behavior. Simulations of energy use from 1960 to 1976 show that the model accurately predicts historical data on aggregate energy use, energy use by fuel, energy use by end use, and equipment ownership market shares.

55364 **Hot water booster.** Kauffmann, W.E. US Patent 4,090,474. 23 May 1978. Filed date 4 Jun 1976. 4p.

A water heating system is described that is comprised of an exhaust gas water preheating coil supplying water via a storage tank to a water heating boiler.

55365 **Problem of increased heat consumption due to wind. Investigations of central-heated apartment houses.** Frank, W. (Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.V., Stuttgart (Germany, F.R.). Inst. fuer Bauphysik). *Gesund.-Ing.;* **99**: No. 1/2, 3-7(Jan 1978). (In German).

As a result of today's critical look at all questions concerning the waste of energy, the problems of heating energy consumption in apartment buildings due to the wind gain in significance. Thus, hitherto not published investigation material relating to question of wind-dependent heat consumption was looked at critically and evaluated with a view to its significance for possible energy conservation proposal.

55366 **Sectoral macro- and micro-analysis of energy application in households and by small consumers.** Geiger, B. *VDI (Ver. Dtsch. Ing.) Ber.;* No. 282, 19-27(1977). (In German).

From Meeting on the application of energy at the final consumption stage - analysis, planning, techniques; Schliersee, Germany, F.R. (17 - 18 May 1977).

The development of energy consumption, in particular for space heating and hot water heating, was investigated taking into account important parameters and reference values. This kind of energy consumption accounts for about 85% of household energy requirements, which means that trends in thy consuming sector show the way to save energy. The consumption analysis is a basis for a national economic energy, consumption forecast as well as for the assessment of the possibilities to use energy efficiently.

COMMERCIAL AND INDUSTRIAL BUILDINGS

55367 (Pub—242(Suppl.)) **Conceptual design report: Chemical Sciences addition, Building 62 Lawrence Berkeley Laboratory.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1978. Contract W-7405-ENG-48. 12p. Dep. NTIS, PC A02/MF A01.

The objective of this study is to determine the energy conservation design features that are to be included in the conceptual design budget of the Building 62 Chemical Sciences addition. The study is based on DOE (ERDA) Appendix 6301 and Life Cycle cost policies of DOE (ERDA) 76 130. Several design criteria exist for the Building 62 Chemical Sciences addition. DOE (ERDA) Appendix 6301 controls maximum heat flux that, in combination with the internal temperature requirements and the specified weather design conditions, results in maximum acceptable U values. ASHRAE Standard 90-75 and California Title 24 are used except where modified by DOE (ERDA) Appendix 6301. Programs for this building require laboratories, offices, conference rooms, toilets and corridors. Fifty percent of the laboratories will need air conditioning due to the esearch requirements for year-round controlled temperature. Air flow will be the minimum values shown in ASHRAE 62-73.

TRANSPORTATION

REFER ALSO TO CITATION(S) 55229

55368 **Energy demand and environmental protection in German transport.** Froboess, U. (Bundesbahn-Zentralamt, Minden (Germany, F.R.)). *ETR (Eisenbahntech. Rundsch.);* **26**: No. 7/8, 509-516(Jul 1977). (In German).

After describing the development of primary energy demand, the conversion to final energy, and the covering of remaining requirements by imports in the period between 1963 and 1974, the article deals with developments in energy consumption in the four modes of transport, and the different technical conditions of road and rail transport. Special consideration is given to the results of the changes in the DB's motive power services, including the reduction in pollution by the elimination of harmful emissions and the substantial drop in energy demand with simultaneous increase in transport performance.

RAILWAY

REFER ALSO TO CITATION(S) 55611

55369 (HCP/M2957—01) **Exploratory study of adapting or developing collapsible containers and inter-liners for use in specialized rail and barge equipment.** (Snitzer (James R.) Associates, Inc., Camp Springs, MD (USA)). Jun 1978. Contract EC-77-X-01-2957. 118p. Dep. NTIS, PC A06/MF A01.

A significant portion of rail and barge transportation energy is consumed unproductively in freight operations through the necessity of making empty backhauls. In 1975 the transport of empty railcars accounted for more than 45% of the total freight car-miles and nearly 25% of the gross ton-miles. Despite economic and energy penalties, empty car mileage has increased in recent years. Clearly, a reduction in empty railcar and barge mileage could lead to significant reductions in rail and barge energy consumption. Results are presented of an exploratory investigation into the use of collapsible containers and interliners as specialized equipment for railcars and barges as a means of reducing empty backhauls. Potential solutions to the technical and regulatory requirements and the economic problems associated with the use of such containers and interliners are presented. Recommendations on further research including the direction and scope are also presented.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 55262, 55263

55370 (NTIS/PS—78/0182) **Railroad freight transportation. Volume 2. 1975-February, 1978 (a bibliography with abstracts). Report**

for 1975-Feb 78. Young, M.E. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 157p. NTIS PC N01/MF N01.

The citations deal with freight car design, electronic engineering, economic impacts, intermodal systems, energy, scheduling, rolling stock utilization, rail revitalization, territorial distributions, cost analyses, computer applications, testing programs, and characteristics within specific regions. (This updated bibliography contains 152 abstracts, 50 of which are new entries to the previous edition.)

55371 Sectoral macro- and micro-analysis of energy application in transport. Prechtl, H. *VDI (Ver. Dtsch. Ing.) Ber.;* No. 282, 41-45(1977). (In German).

From Meeting on the application of energy at the final consumption stage - analysis, planning, techniques; Schliersee, Germany, F.R. (17 - 18 May 1977).

An analysis of the development in the various transport sectors during the period 1950 to 1975 makes it clear that the increase in final energy consumption in transport was brought about by land transport. Structure, development trends, and possibilities to use energy in the transportation sector more efficiently were investigated.

SEA AND WATER

REFER ALSO TO CITATION(S) 55369

55372 (AD-A—050437) **Destroyer engineered operating cycle (DDEOC). System maintenance analysis FF-1052 class fuel oil service and transfer system, SMA 112-260. Review of experience.** Kisinger, T.J. (Arinc Research Corp., Annapolis, MD (USA)). Jul 1977. Contract N00024-76-C-4319. 46p. NTIS PC A03/MF A01.

This report, the Review of Experience, documents the historical maintenance experience for the FF-1052 Class Fuel Oil Service and Transfer System, presents an analysis of the problems encountered, and recommends actions to improve system material condition.

INDUSTRY AND AGRICULTURE

55373 (NP—23079) **Changes in the economic and technical production conditions in the iron and steel industry of the FRG, and their effects on energy consumption until 1985.** Berden, W. (Koeln Univ. (Germany, F.R.). Wirtschafts- und Sozialwissenschaftliche Fakultaet). 16 Dec 1975. 290p. (In German). Dep. NTIS (US Sales Only), PC A13/MF A01.

Thesis.

The determination of the future production volume of the iron and steel industry is predicted and the production conditions, the raw materials supply, and the cost situation of the iron and steel industry are analyzed. An estimate is given of the development of the production structure of the German iron and steel industry to 1985. As a further important parameter, the development of the specific energy consumption in iron and steel industry firms was studied. On this basis, a forecast on the development of energy consumption in the iron and steel industry, according to energy carriers, is made to 1985. The highest increase in consumption is expected for natural gas and electric power. In case of a nearly stagnating total net energy consumption in the iron and steel industry, a strong decrease in liquid fuel and natural gas consumption must be anticipated.

55374 Energy conservation at Erie Mining Company. Tittman, D.W. (Erie Mining Co., Hoyt Lakes, MN). pp 36p, Set No. 14, Paper 2 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Various methods of practical energy conservation are reported. Fractional changes (3 to 40%) in many operations added up to a considerable amount on the whole operation (some hundred thousand dollars). The strategy of planning an energy conservation program and motivating people are discussed. (LTN)

55375 Energy conservation in cement industry. Visvesvaraya, H.C. *Indian East. Eng.;* No. 119, 91-95(1977).

In any manufacturing process the total energy expended includes indirect energy, such as the energy used to produce and transport the raw and finished materials, and the processing equipment and for waste handling, and direct energy used in the production process, such as fuels and electric power. Data are presented on both indirect and direct energy use in the cement industry, and recommendations are made for energy conservation improvements in equipment and processes for producing cement. (LCL)

ENERGY SOURCES

55376 Waste gas recovery. Jensen, L.F.; Hartzell, F.D.; Hutchison, W.S. (to Mobil Oil Corp.). US Patent 4,095,934. 20 Jun 1978. Filed date 24 Mar 1977. 6p.

An important fuel saving is achieved by recovering fuel gas from the pressure relief system of a processing complex such as an oil refinery without impairing safety features.

MATERIALS

55377 (TID—28553) **Polymers and enery conservation workshop summary, Washington, D.C., November 3—4, 1977.** (Courtesy Associates, Inc., Washington, DC (USA)). 1977. Contract EC-77-C-03-1387. 34p. Dep. NTIS, PC A03/MF A01.

The workshop was held to introduce members of the polymer community to the energy conservation programs of the Department of Energy and to determine what DOE programs related to the use, production, and recycling of polymers should be pursued. The general conclusions and recommendations of the Polymers and Energy Conservation Workshop are as follows: There is a need for more technology transfer on the part of the Federal Government in order to assist industry in adopting some of the new energy efficient technologies. Emphasis should be placed on development of new polymeric materials and processes which consume less energy and/or can utilize feedstocks or energy sources other than petroleum and natural gas. The DOE should consider sponsoring fundamental research in areas which are related to recycling of polymeric materials. The Federal Government should initiate tax incentives or subsidies to stimulate the plastics recycling area. More R and D should be sponsored in investigation of combustion of solid municipal waste including the problems of chlorine-containing polymers. Materials research related to recycling polymers including corrosion and materials of construction for heat recovery devices should be increased. It would be very useful to have a comprehensive economic study of recycling/reuse of plastics versus using waste plastics as a fuel. The safety aspects of increased use of plastics in automobiles should be considered by the Federal Government. An important general area for polymer R and D as related to energy would be investigations of basic mechanisms of polymer degradation and the effects of the environment on the degradation rates and mechanisms.

55378 Lead in the Eighties: main effects and forecast. Craig, D.B. (Saint Joe Minerals Corp. (USA)). *Metall;* **31**: No. 9, 1011-1014(Sep 1977). (In German).

In principle, a slight increase in consumption and - accordingly - in supply can be predicted for lead in the Eighties. Its use in gasoline will decrease and its use in batteries will increase; other applications will lose in importance. There is a danger that environmental problems may lead to limitations for its production and application and thus to a marked rise in production costs. On the other hand, if the industry takes the initiative, lead might play an important role in the new energy storage technology, so that lead consumption may also greatly increase during the next decade.

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 55192, 55298

55379 Statistics of the economy - figures of the energy economy and the iron and steel industry from January to December 1977 on the basis of statistical data from the Kohlenwirtschaft e.V. *Glueckauf;* **114**: No. 12, 533-534(Jun 1978). (In German).

The following topics are discussed: energy consumption of important consumer groups - arranged according to energy carriers; electric power generation and supply; and figures from the iron and steel industry in the FRG.

55380 Sectoral macro- and micro-analysis of end energy application in industry. Ebersbach, K.F. *VDI (Ver. Dtsch. Ing.) Ber.;* No. 282, 29-34(1977). (In German).

From Meeting on the application of energy at the final consumption stage - analysis, planning, techniques; Schliersee, Germany, F.R. (17 - 18 May 1977).

The development of industrial energy consumption during the period 1960 to 1975, arranged according to energy carriers and consumers, was investigated. Data for the year 1973 are analyzed more closely. Illustrated by some examples, it is demonstrated with the aid of an energy consumption comparison, the possibilities for energy conservation that might result from a change in technological processes.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 55192, 55257, 55289, 55442

55381 (NTIS/PS—78/0294) **Waste heat utilization (citations from the NTIS data base). Report for 1964-Mar 78.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 258p.

Federally-funded research on techniques of recovering waste heat from power plants, buildings, industrial processes, and waste disposal is covered. Studies of waste heat boilers and the use of waste heat for irrigation, sewage treatment, odor control, desalination, heating, and aquaculture are included. (This updated bibliography contains 253 abstracts, 37 of which are new entries to the previous edition.)

55382 (NTIS/PS—78/0295) **Waste heat utilization. Volume 2. 1975-1976 (citations from the Engineering Index Data base). Report for 1975-76.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 187p.

Worldwide research of waste heat from industrial process plants, electric power plants, buildings, and incineration of wastes is covered. Emphasis is on energy conservation in industrial plants. Studies of waste heat boilers and the use of waste heat for irrigation, sewage treatment, odor control, desalination, and heating are included. (This updated bibliography contains 180 abstracts, none of which are new entries to the previous edition.)

55383 (NTIS/PS—78/0296) **Waste heat utilization. Volume 3. 1977-March 1978 (citations from the Engineering Index Data base). Report for 1977-Mar 78.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 160p.

Worldwide research of waste heat from industrial process plants, electric power plants, buildings, and incineration of wastes is covered. Emphasis is on energy conservation in industrial plants. Studies of waste heat boilers and the use of waste heat for irrigation, sewage treatment, odor control, desalination, and heating are included. (This updated bibliography contains 153 abstracts, 120 of which are new entries to the previous edition.)

55384 (ORNL/TM—6222) **State-of-the-art review of heat-recovery processes.** Gambill, W.R.; Reed, W.R. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-26. 80p. Dep. NTIS, PC A05/MF A01.

A review was conducted of industrial heat-recovery processes and related equipment of potential benefit to coal-conversion complexes. Major categories of heat-exchange processes and equipment investigated included special shell-and-tube; periodic-flow and rotary regenerators; heat pipe arrays; direct phase contactors; steam and organic Rankine cycles for power generation from waste heat; and heat-pump applications to distillation. The importance of heat recovery and utilization in coal-conversion plants is widely recognized, as are the general problems associated with the design of the exchangers. A review of past experience in operating coal-conversion plants and of some proposed designs indicates that many flows will be in the laminar or transition regimes and that overall heat-transfer coefficients for exchangers involving at least one process stream will be low (less than or equal to 100 Btu/hr.ft^{2}.^{0}F). Discussions with individuals knowledgeable in the process heat-transfer field revealed a relatively high degree of unanimity in that design of these exchangers would be more difficult than would their fabrication. Designs are based on the process and property data provided and construction materials specified by the buyer. No warranties are made concerning material lifetime or effect of fouling on performance. There is a clear need for more physical-property data (especially viscosities), improved heat-transfer correlations for multiphase streams (coal-oil and coal-water slurries, e.g.), and rates of fouling, corrosion, and erosion.

55385 **Testing regenerative heat exchangers for thermal cleaning plants for exhaust air.** Banski, H. *Brennst.-Waerme-Kraft;* 30: No. 5, 215-220(May 1978). (In German).

Thee use of regenerators with rotating storage material in thermal cleaning plants for exhaust air, especially with investigations on a heavy type of steam generators is discussed. The tests were concerned with the thermal combustion of exhaust air with and without heat transfer at changing operational variables. The residual loads were measured after the combustion chamber, with and without preheating. It has already been observed that an oxidative decomposition of organic components took place in the regenerator. Then follows a simple design of the combustion chamber and of a compact plant which combines heat exchanger and combustion chamber. Construction and operational results of this plant are described.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 54348, 54952, 55400, 55528, 55529

55386 (AD-A—050881) **Solid waste source separation experiment NCBC, Port Hueneme. Final report Feb 76-Jun 77.** Ward, C.J.; Miller, W.V. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Dec 1977. 71p. (CEL-TN—1507). NTIS PC A04/MF A01.

Recently promulgated EPA guidelines on solid waste source separation, mandatory for Federal agencies, have placed a high priority on the test and evaluation of alternative approaches and of additional costs attributable to source separation. A four-month long test at the Naval Construction Battalion Center, Port Hueneme, California, called for basewide voluntary source separation of solid waste into two categories during 1976. The test was oriented toward waste heat recovery from the combustibles (for steam generation) which, although at odds with the EPA guidelines for source separation, is in the best interest of energy conservation since Navy shore facilities typically use steam for base heating needs. Considered a successful test, indicating the workability and cost-effectiveness of source separation, it generated a large amount of information on the various technical, cost and human factors associated with source separation.

55387 (PB—277444) **The potential for reusable, homogeneous containers. Final report.** Goen, R.L.; Steele, R.V.; Somogyi, L.P.; Parks, T.R.; Fishman, N. (Stanford Research Inst., Menlo Park, CA (USA)). Jul 1977. 83p. (SRI-CRESS—25).

The widespread use of disposable packaging in the United States not only expends considerable energy and materials but also contributes to a rapidly growing solid waste problem. The introduction of reusable, homogeneous containers into the packaging market could contribute significantly to the alleviation of these problems. This study examines the feasibility of reusable containers for food products (excluding beverages). Concepts are formulated for reusable containers, including consideration of configuration and type of material. The energy used and material for the reusable container systems are compared with those of the present container systems. The costs of returning the empty containers are estimated. Potential technical problems are identified. The concept of reusable food containers appears promising, but technical problems remain to be resolved, and implementation strategies must be developed.

55388 (SVF—55) **Possibilities of increased recovery of condensate from live steam in pulp mills.** Loewenberg, L. (Stiftelsen foer Vaermeteknisk Forskning, Studsvik (Sweden)). Sep 1977. 34p. (In Swedish). Dep. NTIS, PC A03/MF A01.

In order to show the degree of recovery of condensate from live steam in existing pulp and paper mills, a collection of possible steam consumers is presented. Some problems with the recovery of condensate are shown and the economical consequence of the distance are presented. If the annual installment is 30%, even fairly small quantities of condensate are profitable to return to the power house. 0.1 ton per hour of steam can be piped about 250 m and be economical. Some problems with contamination are shown. Problem solutions are given as filtering, softening, filtering in mixed bed with its temperature problem and problems with oil and liquor contamination of condensate. An estimation of the total saving potential in the Swedish pulp and paper mills has been done. Condensate at a value of about 7 Mkr per year is possible to recover for re-use. Condensate from heating of houses and industrial buildings is possible to recover at a value of about 4 Mkr/year and general losses and leakages are estimated to be decreased with about 5 Mkr/year. With the restriction for the defective statistical foundation the total saving potential for the Swedish pulp and paper industry is estimated to about 16 Mkr/year. Looking at individual mills the possibilities to find more saving opportunities are greater.

55389 (SVF—57) **Efficient burning of wood waste.** Rydin, O. (Stiftelsen foer Vaermeteknisk Forskning, Studsvik (Sweden)). Dec 1977. 41p. (In Swedish). Dep. NTIS (US Sales Only), PC A03/MF A01.

Bark and other wood waste, hogged fuel, is commonly burned in Scandinavian pulp- and lumber mills. Combined burning together with fuel oil is a common scheme in the pulp mills. Some problems, e.g., decreased efficiency in burning, are discussed, and a joint Scandinavian research programme is proposed. The purpose of the program is to investigate: (1) the formation and composition of fireside tube deposits in combined bark and oil fired boilers; (2) the influence of oil additives on such deposits, i.e., the possibility of reducing flue gas temperature from combined fired boilers without creating corrosion or dust deposition problem; (3) the corrosion of different superheater materials when bark containing chlorides is burned, and (4) the impact of bark moisture on boiler efficiency, capacity and dust carry over.

55390 (TID—28286) **Analysis of the recycling of metals. Final report.** Munir, Z.A.; Fuss, E.; Ivers, L. (California Univ., Davis (USA)). 1 Jan 1978. Contract EY-76-S-03-1187. 297p. Dep. NTIS, PC A13/MF A01.

In order to identify areas where recycling processes can be enhanced, an analysis of primary and secondary metal production methods is presented. Technical and economic difficulties are identified, and general suggestions are made for both possible improve-

ments and future work. The availability of certain industrially important metals can be limited by highly localized ore deposits, diminishing deposits, or general inaccessability; therefore, attempts were made to identify possible substitutes for these critical materials.

55391 Recovery and reuse of paint solids from waste water. Brennan, T.P. (to Drew Chemical Corp.). US Patent 4,096,061. 20 Jun 1978. Filed date 5 Jan 1977. 2p.

A latex base paint waste water containing dispersed paint solids is clarified by flocculating the paint solids with a cationic flocculant. The separated paint sludge is brought to an alkaline pH and treated with an anionic dispersing agent whereby the sludge can be used in the formulation of a latex base paint.

55392 Recovery of sulfur, uranium and gold from residues in OFS scheme. Ruhmer, W.T.; Botha, F. (Anglo American Corp. of South Africa Ltd., Johannesburg); Adams, J.S. *S. Afr. Min. Eng. J.;* **89**: No. 4137, 51, 53, 55, 57, 59(Feb 1978).

This article describes a project comprising three plants for the flotation of pyrite, a twin-stream uranium plant in which high-grade slimes and pyrite can be leached separately, a pyrite burning sulfuric acid plant, and a plant for the recovery of gold from calcines. Details of these plants including capital costs and estimate production are given.

55393 Treatment of scrap accumulators. *Metall;* **32**: No. 2, 166-167(Feb 1978). (In German).

The paper reports on treatment of scrap-accumulators with nearly 100% recycling of lead content. The mechanical plant operates at low cost and safely.

55394 Treatment of liquid copper alloy material in a scrap metal converter. Fleischer, G.; Kammel, R.; Lembke, U. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Metallforschung; Berliner Kupfer-Raffinerie G.m.b.H. (Germany, F.R.)). *Metall;* **32**: No. 2, 129-134(Feb 1978). (In German).

The conventional Knudsen-process for the recovery of secondary copper from scrap and other copper bearing materials by combined blast furnace and converter operation has been investigated with the aim to improve unit operation and metallurgical efficiency by liquid charging of the converter followed by a two-step raffination and volatilization operation.

55395 Utilization of solid wastes: specific problems of developing countries. Rolz, C. *Interciencia;* **3**: No. 3, 160-170(1978). (In Spanish).

A distinction is made between industrialized and developing countries but a common denominator is identified: the imperative need to consider wastes and by-products as possible sources of fibers, fuels and food. A classification of agroindustrial wastes is proposed to better define their complex nature and composition. Most of these wastes are generated from cultivation and processing of annual cash and staple crops, from forestry operations and from large scale animal product factories. Cellulose is the biopolymer most often found in solids such as bagasse, stalks and skins, although it is always closely associated with lignin, hemicelluloses, pectins, proteins and complex polysaccaharides. Evaluation of alternatives to recover economically a product from waste is an exercise which must be performed in each particular case. Leaving generalities aside, agroindustrial wastes and by-products from sugar cane and coffee are discussed in more detail. The first type of processes studied are those where there is direct use of cellulose fiber from solid wastes. Consideration of feed and food products is as follows: aerobic composting and ensilage, microbial protein production either directly from the biopolymer or from its enzymatic hydrolysis products. Processes where biopolymers are used as a source of energy are then discussed, i.e., direct combustion and total anaerobic digestion. Finally, a detailed discussion is given of the process of filamentous fungal growth in open tank bubble aerated ferments, using coffee wastes. A process which is being developed to produce ethanol directly from sugar cane is discussed as a possible example of a new generation of processes designed for agroindustrial zones where the generation of wastes and the use of energy are minimized, and self-sufficiency is maximized.

55396 Total use of mineral components of coals. Ruban, V.A. *Khim. Tverd. Topl.;* No. 3, 150-155(May 1977). (In Russian).

The mineral part of coal and shales can be used as a raw material for fuel recovery, highway materials, porous fillers, architectural ceramics, and to produce concentrates of trace elements, aluminium and silicon compounds. The physical and chemical processes involved in the recovery of these products are reviewed.

55397 New legislation governing the disposal of solid wastes: implications for the minerals industry. Kesten, S.N. (ASARCO Inc., New York). pp 16p, Set No. 5, Paper 4 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

In developing the Resource Conservation and Recovery Act, Congress took note of the increasing quantity of solid waste resulting from technological advances, increased population and greater affluence, and of the concentrations of waste in and around centers of population. Congress also noted that whereas the collection and disposal of solid waste should be functions of state, regional and local agencies, related problems are national in scope requiring federal know-how and financial assistance for solution. Congress also considered the impact that current disposal practices have and will have upon environmental values and public health. Finally, Congress decided that it was high time that both materials and energy resources now being discarded were recovered and utilized economically. The statute provides for financial and technical assistance to the states and other governments in developing better methods of collection, segregation and recovery and environmentally acceptable methods of disposal of non-recoverable residues. Future open dumping is prohibited; present open dumps must be upgraded to sanitary landfills; treatment, storage, transportation and disposal of hazardous wastes are regulated; guidelines are provided for collection, transport, separation, recovery and disposal practices and systems for solid wastes; and other good things are included in the Act. Many sections of the statute involve the government in the conservation and recovery of solid wastes.

55398 Research and development for securing the raw material supply. Program study: 'Chemical engineering: raw materials, processes and products'. Vol. 3. Electrochemical processes. Frankfurt am Main, Germany, F.R.; K. Schmitt (1976). 354p. (In German).

This contribution to the raw material assurance program of the Ministry for Research and Technology contains facts concerning important technical electrochemical processes, a description of their development tendencies and possibilities as well as proposals for sophisticating these processes and developing new ones. After a discussion of the question in which instances electrochemical processes are superior to other chemical processes, the following subjects are dealt with: a) Electrochemical processes of metal production, of inorganic electrolysis, of organic electrosynthesis, plasma chemistry, thermoelectricity and separation, b) electrochemistry of metal organic compounds, of carbon and its oxides, c) indirect electrochemical processes, d) electrochemical process engineering, surface techniques, energy production and energy storage, as well as e) consequences for a R+D program. Related programs in progress are listed in the annex.

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 55255, 55256, 55359

CONSERVATION SERVICES

REFER ALSO TO CITATION(S) 55208, 55260, 55263

PUBLIC SERVICES

REFER ALSO TO CITATION(S) 55269

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 55269, 55308

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 54798, 54800, 55243, 55269

55399 (AD-A—050882) **Project trash: total refuse advanced systems handling. Final report Jun 75-Sep 77.** Ward, C.J.; Miller, W.V. (Civil Engineering Lab. (Navy), Port Hueneme, CA (USA)). Dec 1977. 31p. (CEL-TR—858). NTIS PC A03/MF A01.

Preliminary and conceptual designs of alternative approaches to a small-scale solid waste transfer/resource recovery station were developed. Equipment components and processes were examined, and their life-cycle costs were compared. Selected modules were combined to process two types of solid waste: (1) completely mixed waste and (2) waste from which most glass and metals had been source-segregated. All system designs were ranked according to life-cycle cost. A solid waste two-component source-segregation experiment was then conducted to resolve questions of workability and to quantify the associated effectiveness and cost factors. In addition, a computer program was developed to aid in the economic analysis of proposed changes in waste practices, such as implementation of source segregation, resource recovery, and transfer station operations.

55400 (NP—23203) **Resource recovery and waste reduction: current reports.** (Environmental Protection Agency, Cincinnati, OH

(USA). Solid Waste Management Office). 1977. 18p. Solid Waste Information, Environmental Protection Agency, Cincinnati, OH.

The bibliography contains 88 references to published and unpublished literature on solid waste recycling. The references are arranged by subject. (TFD)

55401 Process and apparatus for incineration of solid fuel material. Barnabe, C.E. (to Passavant Corp.). US Patent 4,092,935. 6 Jun 1978. Filed date 28 Mar 1977. 6p.

A process and apparatus are described for the thermal destruction of solid fuel material in a gravity-type multiple hearth furnace having groups of two or more superimposed hearths. Solid fuel is fed to the upper hearth of each group of hearths. Auxiliary fuel is selectively burned in the lower hearth of each group of hearths to maintain the discharge temperature of the exhaust gas flowing from each said upper hearth above the ignition temperature of said gases so that each group of hearths is operated as a combined drying and burning zone. Preheated air for combustion is introduced into the lower hearth of the lowermost group of hearths so that oxygen available for combustion increases as the solid fuel moves downwardly. Ash is removed from the lower hearth of at least the lowermost group of hearths.

EDUCATION AND PUBLIC RELATIONS

REFER ALSO TO CITATION(S) 55262, 55269, 55312, 55313, 55314

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

55402 I.C. engine having improved air or air-fuel induction system. Kaye, F. US Patent 4,090,479. 23 May 1978. Priority date 23 Jun 1975, Australia. 8p.

An internal combustion engine is described that has at least one cylinder in which at least one piston is reciprocable; the air, or air and fuel, induction being by means of an inlet port giving rise to helical flow of air, or air and fuel within the cylinder. In one form, the inlet port is substantially tangential to the cylinder. The cylinder may have a pair of pistons therein movable in unison to adjacent top dead center positions wherein they define with cylinder wall, an annular combustion chamber.

55403 Pump nozzle for fuel injection in internal combustion engines. Hoefer, G.; Eheim, F.; Kopse, O. (to Robert Bosch GmbH). US Patent 4,092,964. 6 Jun 1978. Priority date 24 Dec 1975, German, Federal Republic of (F.R. Germany). 4p.

Improvements in a fuel injection nozzle for internal combustion engines are described. The improved system has a mechanically driven transport piston and a coaxial slave piston slidably arranged in a cylinder. The positions are arranged to enclose between them an equalizing chamber fed from a line carrying a low pressure fluid and with the line being closed by the boundary edge of the transport piston which faces the equalizing chamber, and more particularly to a structure wherein the fluid in the equalizing chamber as well as that in the pressure line extending to a pressure chamber arranged to receive a needle valve is controllable by means of the slave piston to terminate the fuel injection.

55404 Fuel injection system. Stumpp, G.; Grieshaber, H. (to Robert Bosch GmbH). US Patent 4,090,487. 23 May 1978. Priority date 7 Oct 1975, German, Federal Republic of (F.R. Germany). 8p.

A fuel injection system for externally ignited internal combustion engines is described in which a fuel metering and distributing valve is controlled by an air sensing element disposed in the air suction tube of the engine and by a structure which is adapted to alter the restoring force exerted on the air sensing element through the fuel metering and distributing valve. The structure includes a control pressure conduit, a pressure control valve connected to the control pressure conduit and further conduits for connecting the pressure control valve to the suction tube of the engine downstream of the butterfly valve and between the air sensing element and the butterfly valve. With this structure it is possible to alter the restoring force so that a properly proportioned fuel—air mixture is achieved for various load changes of the internal combustion engine.

55405 Some characteristics of automotive exhaust valve alloys. Kocis, J.F.; Matlock, W.M. (TRW, Inc., Cleveland, Ohio (USA). Valve Div.). *Z. Werkstofftech.;* 9: No. 4, 132-140(Apr 1978).

The pH stainless steels and the nickel-base superalloys, were evaluated for exhaust valve applications by considering their metallurgical, environmental and high temperature strength properties. The PH stainless steels are characterized by their good sulfidation and high temperature strength. Good PbO corrosion resistance was achieved with the low silicon, nickel containing alloys. Stable alloys show the greatest high temperature strength which can be improved further by a solution and age treatment. Aging below the optimum temperature of 760°C results in grain boundary sensitization and low impact properties while higher temperatures produce more of the discontinuous phase. The addition of refractory elements can be detrimental to the oxidation resistance of these alloys. The highest elevated temperature strength and best PbO and oxidation resistance is achieved with the nickel-base superalloys. These alloys are completely stable and the highest strength at elevated temperatures is achieved with a solution and age treatment. These alloys show lower sulfidation corrosion resistance relative to the PH stainless steels, however this can be improved with higher chromium contents.

55406 Supercharger for an internal combustion engine. Gamell, J.A. (to Gamell (J.) Industries, Inc.). German(FRG) Patent 2,553,561/A/. 8 Jun 1977. 33p. (In German).

Most of the present superchargers have the drawback that the engine is not sufficiently charged when cold. Therefore, the invention claims an improved supercharger, with a turbine drive, which will help to increase the power and the rotational speed of the engine. During operation, this supercharger will not be completely dependent on the thermal energy of the exhaust gases. The fluid system proposed for the turbine drive has the following components: an incompressible working fluid, preferably water, which is always kept in its liquid state, and a storage tank for the working fluid. The working fluid is led towards the turbine blades by a nozzle and thus drives the turbine; it is kept flowing by means of a pump which is driven by the internal combustion engine.

55407 Piston for internal combustion engines with a system for varying the compression ratio. Isley, W.F. (to Teledyne Industries, Inc.). German(FRG) Patent 2,212,137/B/. 18 May 1977. 5p. (In German).

The invention aims at a piston for internal combustion engines with a system for varying the compression ratio. This piston will avoid the migration of impurities in the lubricating system to the exhaust valve, which they would keep open, or the fixed oil outlet which they would block against the passage of liquids. Constructional details are given.

55408 Ignition system for an internal combustion engine. Imhof, G. (to Bosch (R.) G.m.b.H.). German(FRG) Patent 2,065,791/A/. 12 May 1977. 5p. (In German).

The invention pertains to ignition systems for internal combustion engines; in particular, these are used in the engines of modern small motorcycles, where power is supplied by means of a so-called flywheel magneto, so that there is no need for an additional battery. The invention will prevent back-kicking. This is achieved by the following means: in the right direction of rotation of the internal combustion engine, due to an axial magnetic unsymmetry of the rotor, a voltage component that can switch the electronic switch will occur only in one of the two parts of the control winding at the point of ignition. In the wrong direction of rotation, on the other hand, this voltage component will only occur in the other part of the control winding and will act in direction on a diode connected in parallel to this part of the winding.

55409 Some unusual engines. Setright, L.J.K. London; Mechanical Engineering Publications Ltd. (1975). 145p. $13.50.

Current concerns for environment and fuel economy have resulted in a renewed interest in unconventional internal combustion engines. The historical development of unorthodox engines is delineated with respect to unusual respiration in charging and scavenging; unusual construction; unusual valve apparatus; unusual format; and unusual translation of power. A final chapter is devoted to future prospects of unconventional engine design. Topics discussed include rotary engines, stratified charge engines, diesel engines, gas turbines, and stirling engines. (PMA)

SPARK-IGNITION

REFER ALSO TO CITATION(S) 55433

55410 Fuel vaporizing and mixing device for gasoline engines. Prosen, G. (to Vortac, Inc.). US Patent 4,092,966. 6 Jun 1978. Filed date 3 Nov 1976. 6p.

A carburetor attachment for easy insertion between a carburetor and a cooperable engine intake manifold is described. The attachment promotes intermixing and efficient vaporization in the air-gas mixture to provide increased gas mileage per gallon of fuel and decreased pollution emission in the engine exhaust, the device includes a sleeve-like structure having internal lands and grooves adapted to provide a swirling, intermixing action in the air-gas mixture entering such an engine intake manifold.

55411 Precarburetor ignition system. Beaton, A.L.; Weygant, N.E. US Patent 4092,962. 6 Jun 1978. Filed date 1 Apr 1976. 10p.

A pre-ignition, combustion system of the type used in combination with an internal combustion engine is described in which a vaporized fuel charge is created due to the exposure of heat to saturated fuel vapor. The fuel vapor is further heated to a point of near combustion immediately prior to introduction into the intake manifold of an IC engine. A thermerator element is provided which defines a heating chamber in which fuel is vaporized due to direct exposure with the exhaust gases of the internal combustion engine through appropriate directing of the introduced fuel or fuel vapor in direct heat transfer relation to the exhaust gases passing through at least a portion of the heating chamber defined in the thermerator. The fuel source including a substantially conventional fuel tank has air supply means leading thereto so as to supply positive air pressure serving to aid fuel passing from the fuel tank into the thermerator through a first fuel supply conduit. At least one additional auxiliary fuel supply line with fuel pump attached thereto is provided for directing fuel into the thermerator on an auxiliary or independent basis.

55412 Carburetion system for preventing engine misfires during gear changes. Yamada, M. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 4,092,961. 6 Jun 1978. Priority date 10 Mar 1977, Japan. 4p.

A carburetion system is disclosed for preventing misfires of an engine during gear changes. The system includes a carburetor idle port and, additionally, an idle and slow port positioned near the throttle valve. Both ports are in communication with an idle and slow fuel passage. A valve controls the entry of air into the slow fuel passage during gear changes. The valve is opened by a circuit which functions to detect the concurrence of (1) the pushed-down position of the clutch pedal; and (2) the idle opening position of the throttle valve. A timing device is included for closing the valve a predetermined period of time after the clutch has been pushed down and the throttle valve has assumed its idle opening position.

55413 Gasoline engine fed with lean mixture only. Ono, J.; Shimoura, A.; Tanaka, Y. (to Daihatsu Kogyo Kabushiki Kaisha). US Patent 4,092,969. 6 Jun 1978. Priority date 16 Aug 1975, Japan. 8p.

A gasoline engine fed with lean mixture only is improved for practical use. The cylinder head of the engine has an area providing intense turbulance in cooperation with the top surface of the piston. It is provided, further, with a torch chamber which emits torch flames sharing the combustion of lean mixture so that the flame propagation distance is decreased. Among the torch flame, one passes through a portion of the combustion chamber just below the center of the head of the suction valve, and another passes through a portion of the combustion chamber just below the center of the head of the exhaust valve.

55414 Fuel-operated device. Brian, W.S. US Patent 4,093,405. 6 Jun 1978. Filed date 2 Feb 1977. 10p.

The invention relates to an apparatus having fuel combustion cylinders for urging the rods of pistons operating therein through power strokes, and fluid pressure pistons, also operating in cooperating cylinders, which are correspondingly urged during said power strokes through movement causing the production of a pressure fluid which is thereafter utilized, on demand, to do work. In the transmission of said movement-producing forces of said fuel-powered apparatus input to said pressure fluid output, a linkage mechanism is advantageously utilized to provide a pressure pattern in the pressure fluid which starts at an optimum low value and progressively builds up. This effectively reverses the pressure pattern of the combustion fuel which consists of a rapid-expansion gas having an initial maximum value and, due to expansion, progressively diminishes in value. In this way, the operation of the within apparatus is characterized by such a high degree of efficiency that in place of gasoline it is feasible to use a non-fossil fuel, such as methanol or the like.

55415 Method of improving operation of internal combustion engines. Gockel, J.L. (to Cragar Industries, Inc.). US Patent 4,090,477. 23 May 1978. Filed date 3 Sep 1976. 6p.

A process and apparatus is described for improving fuel economy and exhaust emissions of internal combustion engines operating at high altitude conditions. The process is comprised of adjustments to spark timing carburetor idling and crankcase ventilation flow to lean out the fuel-air mixture an amount based on the relative elevation in altitude. The process includes the use or modification of a crankcase ventilation modulating valve having novel flow characteristics and produces much greater efficiency than would be expected under the high altitude conditions. The manifold vacuum between the engine carburetor and piston modulates the valve to provide a greater air flow when increased power is demanded from the engine. In addition to coordinating the spark timing with the modulating valve air flow, the process includes a concomitant special adjustment of the engine's speed and fuel air mixture at idle.

55416 Fuel systems for internal combustion engines. LaCreta, M.V. US Patent 4,090,485. 23 May 1978. Filed date 28 Mar 1977. 6p.

A fuel vaporization system for hydrocarbon users, such as internal combustion engines, gas turbines and the like, is described in which the prior art gas generating and carburetor functions are accomplished in a novel chamber or fuel generator with additional benefits afforded through the use of controlled amounts of hydrogen.

55417 Carburetor device, especially for internal combustion engines. Weidlich, F. US Patent 4,090,483. 23 May 1978. Priority date 13 Jun 1975, Sweden. 4p.

A carburetor for an internal combustion engine is described that has a combustion air intake duct, a valve in the duct for controlling the air flow through the duct, a fuel flow regulator in the valve for controlling fuel flow through a downstream portion of the valve in dependence on the air flow, and a turbine associated with the fuel flow regulator. The regulator is driven by the exhaust gases of the engine, the turbine having a rotating tubular hub extending through the valve and surrounding the fuel flow regulator, the tubular hub being connected to the fuel outlet through the valve.

55418 Fuel supply system for multi-fuel internal combustion engines. Itoh, Y.; Shibata, M.; Masuda, A.; Ohtake, Y.; Etoh, M. (to Fuji Jukogyo Kabushiki Kaisha). US Patent 4,090,484. 23 May 1978. Filed date 11 Aug 1976. 6p.

A fuel supply system is described for multi-fuel internal combustion engines having a selector valve for controlling the feed of fuels such as gasoline and kerosene and vacuum actuator to operate the selector valve according to the pressure in intake passage of the engine. The system is provided for feeding the gasoline and kerosene at heavy load and low speed, feeding the gasoline at heavy load and high speed and feeding the kerosene at middle load.

DIESEL

55419 Controlling internal combustion engines. Ball, G.S.M.; Andrews, A.W. (to Exxon Research and Engineering Co.). US Patent 4,092,970. 6 Jun 1978. Priority date 5 Jun 1970, United Kingdom of Great Britain and Northern Ireland (UK). 18p.

A device for controlling maximum speed and/or acceleration of a diesel engine by means of a spring-loaded valve located upstream on the air inlet manifold is described. The valve, which normally is open, operates on a pressure differential basis and is designed to close when maximum speed is exceeded. By sending the air flow rate to the engine, the air flow can be shut off when it exceeds a rate corresponding to an excessive engine speed.

TURBINE

REFER ALSO TO CITATION(S) 55416

55420 (AD-A—050537) **Investigation of a highly loaded two-stage fan-drive turbine. Volume V. Phase III. Boundary layer control optimization and off-design evaluation. Technical report 1 Jan-30 Jun 70.** Welna, H.; Dahlberg, D.E.; Heiser, W.H. (Pratt and Whitney Aircraft, East Hartford, CT (USA)). Jun 1970. Contract F33615-68-C-1208. 266p. (PWA—3967).

A comprehensive, four-phase, three-year program is in progress to investigate methods of improving the performance of fan-drive turbines. The goals of this program are to develop turbine design procedures and aerodynamic techniques for efficient, high work, low pressure turbines. The first phase effort of defining the preliminary turbine design has been completed and the results were reported . The second phase consisted of an experimental evaluation which included establishment of both two-dimensional loss levels and three-dimensional flow behavior for the baseline airfoils, and for airfoils utilizing various boundary layer control methods. The design of the baseline cascade packs and the annular cascade performance of the baseline airfoils has been reported. The annular cascade results of the baseline airfoil boundary layer control methods are reported . The results of the plano-cascade, two-dimensional, baseline investigation the decreased solidity annular-cascade airfoil test results, and the Phase III boundary layer control optimization and off-design evaluation are presented .

EXTERNAL COMBUSTION ENGINES

STIRLING CYCLE

REFER ALSO TO CITATION(S) 55409

RANKINE CYCLE

55421 External combustion power cycle and engine with combustion air preheating. Bourque, R.F. US Patent 4,090,362. 23 May 1978. Filed date 23 Aug 1976. 22p.

A thermodynamic power cycle and engine for motive power is disclosed which uses a condensible working fluid such as water in which the pressurized fluid, after being heated to vapor, is expanded to perform work in two or more stages with low expansion ratios per stage. The working fluid is reheated between one or more of the expansion stages with short reheats having high average heat addition temperatures. For use with a positive-displacement expander, the fluid has suspended in it a finely-divided powdered lubricant, such as calcium difluoride, which is used to lubricate all wear surfaces. After the fluid leaves the expander, it is still superheated and is desuperheated prior to condensing by transferring its energy to the combustion chamber inlet air. This air preheating reduces the fuel quantity required and facilitates the use of difficult-to-burn fuels such as coal dust. The combustion of the fuel and air preferably proceeds to two steps: the first overly rich and the second very lean.

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 55321, 55438, 55611

55422 (HCP/M1011—03/1) **Twelve state-of-the-art individual electric and hybrid vehicle test reports. Volume I.** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jul 1978. Contract EX-76-A-31-1011. 726p. Dep. NTIS, PC A99/MF A01.

Reports resulting from an Energy Research and Development Administration project to characterize the state-of-the-art of electric vehicles are presented. A separate abstract was prepared for each report for inclusion in Energy Research Abstracts (ERA). (PMA)

55423 (HCP/M1011—03/1, pp 1.1-1.113) **Baseline tests of the C. H. Waterman DAF electric passenger vehicle.** Sargent, N.B.; Maslowski, E.A.; Soltis, R.F.; Schuh, R.M. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The Waterman vehicle is a four-passenger DAF 46 sedan that was converted to an electric vehicle. It is powered by sixteen 6-volt traction batteries through a three-step contactor controller actuated by a foot throttle to change the voltage applied to the 6.7-kilowatt (9-hp) motor. The braking system is a conventional hydraulic braking system. Regenerative braking was not provided. At 31 mph, the vehicle had a range of 58 miles with an energy consumption rate of 0.44 kWh/mile. The Waterman DAF was able to accelerate from 0 to 32 kilometers per hour (0 to 20 mph) in 14 seconds and from 0 to 48 kilometers per hour (0 to 30 mph) in 29 seconds. The gradeability limit was 18%. Measurments were made to assess the performance of the vehicle components. The performance was as follows: charger efficiency over a complete charge cycle, 80 to 93%; battery efficiency with 20% overcharge, 63%; controller efficiency, >99%; and motor efficiency at constant speed, 73 to 80%.

55424 (HCP/M1011—03/1, pp 2.1-2.42) **Baseline tests of the AM General DJ-5E Electruck electric delivery van.** Dustin, M.O.; Tryon, H.B.; Sargent, N.B. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The DJ-5E Electruck, an electric quarter-ton truck designed for use as a postal delivery vehicle, was tested as a part of an Energy Research and Development Administration (ERDA) project to characterize the state-of-the-art of electric vehicles. The Electruck vehicle performance test results are presented. The Electruck is an AM General Corp. jeep that has been converted to an electric vehicle. The Electruck is powered by a single-module, 54-volt industrial battery through a silicon-controlled rectifier (SCR) continuously adjustable controller with regenerative braking applied to a direct-current (dc) compound-wound motor. At 30 mph, the vehicle had a range of 39.3 miles at an energy consumption rate of 0.57 kWh/mile. The Electruck was able to accelerate from 0 to 32 kilometers per hour (20 mph) in 8.7 seconds and from 0 to 48 kilometers per hour (30 mph) in 23.4 seconds. The gradeability limit was 14.4%.

55425 (HCP/M1011—03/1, pp 3.1-3.55) **Baseline tests of the C. H. Waterman Renault 5 electric passenger vehicle.** Sargent, N.B.; McBrien, E.F.; Slavik, R. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The vehicle is a four-passenger Renault 5 GTL that was converted to an electric vehicle. It is powered by sixteen 6-volt traction batteries through a two-step contactor controller actuated by a foot throttle to change the voltage applied to the 6.7-kilowatt (9-hp) motor. The motor output shaft is connected to the standard Renault 5 front-wheel-drive transaxle that contains a four-speed manual transmission and clutch. The braking system is a conventional hydraulic braking system. Regenerative braking was not provided. At 35 mph, the range was 79.7 miles at an energy consumption rate of 0.33 kWh/mile. The Waterman Renault 5 was able to accelerate from 0 to 32 kilometers per hour (0 to 20 mph) in 9.3 seconds and from 0 to 48 kilometers per hour (0 to 30 mph) in 34 seconds. The gradeability limit was 37%. Measurements were made to assess the performance of the vehicle components. The performance was as follows: charger efficiency over a complete charge cycle, 80 to 94%; battery efficiency with 10% overcharge, 72%; controller efficiency, >99%; and motor efficiency at constant speed, 75 to 80%.

55426 (HCP/M1011—03/1, pp 4.1-4.43) **Baseline tests of the EPC Hummingbird electric passenger vehicle.** Slavik, R.J.; Maslowski, E.A.; Sargent, N.B.; Birchenough, A.G. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The EPC Hummingbird, an electric passenger vehicle, was tested as a part of an Energy Research and Development Administration (ERDA) project to characterize the state-of-the-art of electric vehicles. The Hummingbird vehicle performance test results are presented. The Hummingbird vehicle is a converted four-passenger Volkswagen "Thing" powered by 12 heavy-duty, lead-acid batteries. The rear-mounted internal combustion engine has been replaced with an electric motor made by modifying an aircraft generator. The motor shaft is connected to the drive train through the conventional Volkswagen 4-speed manual transaxle, including the clutch. The controller is a transistorized chopper with current limiting and thermal overload protection. The braking system is a conventional Volkswagen hydraulic braking system. Regenerative braking was not provided. At a speed of 35 mph, the vehicle range was 23 miles with an energy consumption rate of 0.72 kWh/mile. The Hummingbird was able to accelerate from 0 to 32 kilometers per hour (0 to 20 mph) in 9.4 seconds and from 0 to 48 km per hour (0 to 30 mph) in 22 seconds. The gradeability limit was 22%.

55427 (HCP/M1011—03/1, pp 5.1-5.49) **Baseline tests of the Battronic Minivan electric delivery van.** Dustin, M.O.; Soltis, R.F.; Bozek, J.M.; Maslowski, E.A. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The Battronic Minivan, an electric passenger vehicle, was tested as a part of an Energy Research and Development Administration (ERDA) project to characterize the state-of-the-art of electric vehicles. The Battronic vehicle performance test results are presented. The Minivan is a two-passenger van with sliding side entry doors and a large rear door. It is powered by a two-module, 112-volt semi-industrial battery through an SCR direct-current (dc) chopper controller with bypass contactors. The motor is a 31-kilowatt (42-hp) series-wound dc traction motor. The braking system is a conventional hydraulic braking system. Regenerative braking was not provided. At 37 mph, the vehicle range was 51.2 miles with an energy consumption of 0.98 kWh/mile. The Minivan was able to accelerate from 0 to 32 km per hour (0 to 20 mph) in 7 seconds and from 0 to 48 kilometers per hour (0 to 30 mph) in 11 seconds. The gradeability limit was 50% for 0 to 2 seconds only. The duration was limited because the 400-ampere motor protection fuse failed due to current overload. The efficiency of the battery charger was measured and found to be 85 to 95% over a complete charge cycle.

55428 (HCP/M1011—03/1, pp 6.1-6.54) **Baseline tests of the EVA Contactor electric passenger vehicle.** Bozek, J.M.; Tryon, H.B.; Slavik, R.J. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The EVA Contactor, a four-door sedan, is an electric passenger vehicle tested as a part of an Energy Research and Development Administration (ERDA) project to characterize the state-of-the-art of electric vehicles. The EVA Contactor performance test results are presented. The EVA Contactor is a four-passenger Renault 12 that was converted to an electric vehicle. It is powered by 16 series-connected 6-volt electric vehicle batteries through a four-step contactor controller actuated by a foot accelerator pedal. The controller changes the voltage applied to the separately excited dc motor. The braking system is a vacuum-assisted hydraulic braking system. Regenerative braking was also provided. At a speed of 35 mph, the vehicle range was 35.6 miles with an energy consumption rate of 0.70 kWh/mile. The EVA Contactor was able to accelerate from 0 to 32 kilometers per hour (0 to 20 mph) in 8.8 seconds and from 0 to 48 km per hour (0 to 30 mph) in 15.4 seconds. Measurements were made to assess the performance of the vehicle components. The performance was as follows: charger efficiency over a complete charge cycle, 87 to 92%; battery efficiency with 37% overcharge, 60%;controller efficiency, >99%; and motor efficiency at constant speed, 82 to 85%.

55429 (HCP/M1011—03/1, pp 7.1-7.60) **Baseline tests of the EVA Change-of-Pace Coupe electric passenger vehicle.** Bozek, J.M.; Maslowski, E.A.; Dustin, M.O. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The EVA Change-of-Pace Coupe, commonly referred to as the EVA Pacer, is an electric passenger vehile tested as a part of an Energy Research and Development Administration (ERDA) project to characterize the state-of-the-art of electric vehicles. The EVA Change-of-Pace coupe vehicle performance test results are presented. The EVA Change-of-Pace Coupe is a four-passenger American Motors Pacer that was converted to an electric vehicle. It is powered by twenty 6-volt traction batteries through a silicon-controlled-rectifier chopper controller actuated by a foot throttle to change the voltage applied to the series-wound, direct-current motor. Braking is accomplished with a vacuum-assist hydraulic braking system. Regenerative braking is also provided. At a speed of 35 mph, the vehicle range was 44 miles with an energy consumption rate of 0.45 kWh/mile. The EVA Change-of-Pace Coupe was able to accelerate from 0 to 32 kilometers per hour (0 to 20 mph) in 8 seconds and from 0 to 48 km per hour (0 to 30 mph) in 18 seconds. Measurements were made to assess the performance of the vehicle components. The performance was as follows: charger power efficiency, 93%; battery efficiency with 49% overcharge, 58%; and controller efficiency, <94%.

55430 (HCP/M1011—03/1, pp 8.1-8.34) **Baseline tests of the Zagato Elcar electric passenger vehicle.** Sargent, N.B.; Slavik, R.; Maslowski, E.A.; Soltis, R.F. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The Elcar, an electric vehicle manufactured in Italy, was tested as a part of an Energy Research and Development Administration (ERDA) project to characterize the state-of-the-art of electric vehicles. The performance test results on the Elcar vehicle are presented. The Elcar Model 2000 is a two-passenger vehicle with a reinforced fiberglass body, powered by eight 12-volt batteries. The batteries are connected to the motor through an arrangement of contactors operated from a foot pedal in conjunction with a hand-operated switch. These contactors change the voltage applied to the 2-kilowatt motor. No regenerative braking was provided on this vehicle. At a speed of 25 mph, the vehicle range was 26.4 miles with an energy consumption of 0.32 kWh/mile. The Elcar was able to accelerate from 0 to 32 km per hour (0 to 20 mph) in 8 seconds.

55431 (HCP/M1011—03/1, pp 9.1-9.57) **Baseline tests of the Power-Train electric delivery van.** Lumannick, S.; Dustin, M.O.; Bozek, J.M. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The Power-Train Van, an electric delivery van; was tested as a part of an Energy Research and Development Administration (ERDA) project to characterize the state-of-the-art of electric vehicles. The Power-Train vehicle performance test results are presented. The Power-Train vehicle is a modified Otis P-500 utility van. It is powered by sixteen 6-volt storage batteries connected in series. A General Electric chopper controller actuated by a foot accelerator pedal changes the voltage applied to the 22-kilowatt (30-hp) series-wound drive motor. In addition to the conventional hydraulic braking system, the vehicle has hydraulic regenerative braking. Cycle tests and acceleration tests were conducted with and without hydraulic regeneration. At a speed of 37 mph, the vehicle range was 37.9 miles with an energy consumption rate of 0.51 kWh/mile. The Power-Train van was able to accelerate from 0 to 32 kilometers per hour (0 to 20 mph) in 5.8 seconds and from 0 to 48 km per hour (0 to 30 mph) in 12.7 seconds with the hydraulic regenerative braking disconnected. With the hydraulic system in operation the vehicle accelerated from 0 to 32 kilometers per hour (0 to 20 mph) in 4 seconds and from 0 to 48 kilometers per hour (0 to 30 mph) in 8.5 seconds.

55432 (HCP/M1011—03/1, pp 10.1-10.53) **Baseline tests of the Volkswagen Transporter electic delivery van.** Soltis, R.F.; McBrien, E.; Bozek, J.M.; Gourash, F. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The Volkswagen Transporter, an electric delivery van, was tested as a part of an Energy Research and Development Administration (ERDA) project to characterize the state-of-the-art of electric vehicles. The Volkswagen vehicle performance test results are presented. The Volkswagen Transporter is a standard Volkswagen van that was converted to an electric vehicle. It is powered by a 144-volt traction battery. A direct-current (dc) chopper controller, actuated by a conventional accelerator pedal, regulates the voltage or power applied to the 16-kilowatt (21-hp) motor. The braking system uses conventional hydraulic braking in combination with an electric regenerative braking system. At a speed of 35 mph, the vehicle range was 54.1 miles with an energy consumption rate of 0.65 kWh/mile. The Volkswagen Transporter was able to accelerate from 0 to 32 kilometers per hour (0 to 20 mph) in 7 seconds and from 0 to 48 km per hour (0 to 30 mph) in 14 seconds. The gradeability limit was 14%. Measurements were made to assess the performance of the vehicle components. The performance was as follows: charger efficiency over a complete charge cycle, 78 to 87%; and battery efficiency with 10% overcharge, 77%.

55433 (HCP/M1011—03/1, pp 12.1-12.61) **Performance of conventionally powered vehicles tested to an electric vehicle test procedure.** Slavik, R.J.; Dustin, M.O.; Lumannick, S. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

A conventional Volkswagen Transporter, a Renault 5, an American Motors Corp. Pacer, and a U.S. Postal Service American Motors General DJ-5 delivery van were tested to an electric vehicle test procedure in order to allow direct comparison of conventional and electric vehicles. The tests are part of an Energy Research and Development Administration (ERDA) project to characterize the state-of-the-art of electric vehicles. The performance test results for the four vehicles are presented, including weight, acceleration, gradeability, and energy consumption data. The Volkswagen Transport (Minibus) is a delivery van powered by a 2.0-liter, four-cylinder opposed, air-cooled, fuel-injected engine.The Renault 5 is a passenger vehicle powered by a carbureted, 1.3-liter, four-cylinder in-line, liquid-cooled engine. The AMC Pacer is a passenger vehicle powered by a carbureted 4.2-liter, six-cylinder in-line, liquid-cooled engine. The U.S. Postal Service vehicle is an AM General DJ-5. It is powered by a carbureted, 3.8-liter, six-cylinder in-line, liquid-cooled engine. Two series of tests were conducted on the vehicles. One series was performed at a test weight equivalent to the vehicle's curb weight plus its electric vehicle counterpart's payload. The other series was performed at a test weight equivalent to the gross vehicle weight listed on the placard attached to the vehicle body.

55434 **Swedish power for BR as APT gets under way.** *Engineer (London);* **246**: No. 6377, 62-63(15 Jun 1978).

A discussion is given of power systems for the APT project (Advanced Passenger Train, British Rail) which is designed to be a cost-effective solution to the problem of providing fast inter-urban transport on existing tracks. It is intended to offer rail transport which everyone can afford, unlike high speed rail travel in other countries where a supplement is often charged as on the Trans European Express. Total costs (initial cost plus energy and maintenance expenses) per seat-kilometer over the life of the train are designed to be comparable with the High Speed Train. With a top speed of 155 mile/h, the APT is designed to cut journey times by its ability to corner at high speeds, typically 20 to 40% higher than conventional trains. Above 100 mile/h increases of speed result in only minimal time savings on all but the straightest routes.

55435 **E/HV standards as proposed by DOE.** *Electr. Veh. News;* 7: No. 2, 18-21(May 1978).

Excerpts from performance standards for electric and hybrid electric vehicles proposed by the US Department of Energy are presented. The standards specify only minimum levels and include acceleration, gradeability, top speed, range, battery life, and test procedures. (PMA)

55436 **Look down the road beyond 2000: a scenario of battery electric vehicle market evolution.** Dickson, E.M.; Walton, B.L. *Electr. Veh. News;* 7: No. 2, 27-29(May 1978).

SRI International (formerly Stanford Research Institute) is performing a technology impact assessment of electric vehicles for the Transportation Energy Conservation Division of the Department of Energy. The assessment considers both vehicles that use batteries to store all their needed energy, and hybrid vehicles that use batteries to store most of their needed energy but have also a small, gasoline powered internal combustion engine to extend the vehicle range when necessary. The hybrid vehicle is one that has been conceptually designed by SRI specifically for this study. A scenario is presented of the manufacture, sale, and use of electric vehicles, extending from the present to the early 21st century. The changing character of the manufacture of electric vehicles and the effects of foreign competition are key ingredients in the scenarios.

55437 **Electric vehicles used at Osadano Industrial Complex in Kyoto Prefecture.** Morohashi, K.; Ohmori, M. *Yuasa Jiho;* No. 44, 69-79(Apr 1977). (In Japanese).

About 3 years have passed since an electric vehicle lease plan was realized at Osadano Industrial Complex in Kyoto Prefecture. Now, 37 electric vehicles, including electric fork-lift trucks for in-plant use, are in use. They are leased out to factories located there through Osadano Industrial Center, Inc., with financial support by the Kyoto Prefecture as well as maintenance support by Yuasa Battery Co., Ltd. The state of electric vehicles in use, the lease systems, the electric vehicle service station, etc., are described with

the hope that this will provide some useful information for popularizing the electric vehicle in future. 12 figures, 8 tables.

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 55321, 55435, 55436

55438 (HCP/M1011—03/1, pp 11.1-11.67) **Baseline tests of the Kordesch hybrid passenger vehicle.** Soltis, R.F.; Bozek, J.M.; Denington, R.J.; Dustin, M.O. Jul 1978.

In Twelve state-of-the-art individual electric and hybrid vehicle test reports. Vol. I.

The Kordesch hybrid passenger vehicle is propelled by an electric motor that receives its energy from a spark-ignition-engine-driven alternator and an electric battery system. It was tested as a part of an Energy Research and Development Administration (ERDA) project to assess the state-of-the-art of electric and hybrid vehicles. The Kordesch hybrid vehicle performance test results are presented. The Kordesch hybrid is a four-passenger Austin A40 sedan that has been converted to a heat-engine-alternator- and battery-powered hybrid. It is propelled by a conventional, gasoline-fueled, heat-engine-driven alternator and a traction battery pack powering a series-wound, 7.5-kilowatt (10-hp) direct-current electric drive motor. The propulsion battery consists of eight 12-volt batteries connected in series. The electric motor is coupled to a four-speed standard Austin transmission, which drives the rear wheels. Power to the motor is controlled by a three-step foot throttle, which actuates relays that control armature current and field excitation. The vehicle test results show that the range of the hybrid vehicle can be significantly extended if on-board fuel is used to power the heat-engine-driven alternator to produce electric power for the drive motor. But because some energy is supplied by the battery, the range is still limited. At a constant speed of 40 km per hour (25 mph) the range of the Kordesch vehicle operating with the heat engine turned off is 43 kilometers (27 miles). The Kordesch hybrid accelerates from 0 to 32 km per hour (0 to 20 mph) in 7.5 seconds and from 0 to 48 km per hour (0 to 30 mph) in 14 seconds. At a speed of 32 km per hour (20 mph) the vehicle can negotiate a 9.6% grade.

VEHICLE DESIGN FACTORS

55439 (NTIS/PS—78/0265) **Tracked air cushion vehicle and magnetic levitation (citations from the NTIS data base). Report for 1964-Feb 78.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 132p.

The feasibility, design, and track dynamics of tracked air cushioned and magnetically levitated vehicles are investigated in these Government-sponsored research reports. (This updated bibliography contains 127 abstracts, 7 of which are new entries to the previous edition.)

55440 (NTIS/PS—78/0266) **Tracked air cushion vehicles and magnetic levitation (citations from the engineering index data base). Report for 1970-feb 78.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 285p.

The feasibility, design, and track dynamics of tracked air cushioned and magnetically levitated vehicles are investigated in these abstracts of reports gathered in a worldwide literature survey. (This updated bibliography contains 278 abstracts, 24 of which are new entries to the previous edition.)

55441 **Automatic train control in rail rapid transit.** Washington, DC; United States Congress (1976). 251p. $3.15.

The report given, prepared by OTA (Office of Technology Assessment) at the request of the Senate Committee on Appropriations on behalf of the Transportation Subcommittee, is an assessment of the technology of automatic train control in rail rapid transit systems. Automatic train control (ATC) is the general designation for a variety of techniques by which machines regulate the movement of rail rapid transit vehicles for the purposes of safety and efficiency. Functionally, ATC includes: train protection; train operation; train supervision; and communication. The use of the term "automatic" does not imply that train control or any of its constituent functions is carried out wholly without human involvement in operating the equipment or in overseeing automated devices. Rather, automatic is used to denote systems in which machines perform a substantial part of the routine functions and there is minimal reliance on man as an operational element. Man's role in such systems is to monitor the performance of automatic elements and to act as the ultimate safety backup. Because of the number and complexity of the issues to be addressed, the complete technology assessment made was divided into three separate, but coordinated, studies dealing with (1) the planning process, (2) automated small vehicle systems, and (3) automatic train control in rail rapid transit. Reports on the first two topics have been published in separate volumes. This report deals with the third topic, specifically the degree of automation which is technically feasible, economically justifiable, or otherwise appropriate for rail rapid transit. The report contents include: findings; background; automatic train control; transit system descriptions; operational experience; the planning and development process; and policy and institutional factors.

ENGINE SYSTEM

REFER ALSO TO CITATION(S) 55409

55442 **Turning waste heat into useful energy.** Kerr, J. *Engineer (London);* **246**: No. 6376, 49, 82(8 Jun 1978).

Two systems for waste heat recovery and utilization are described, one for automobiles, and another for industrial plants. The automobile arrangement operates on the Rankine thermodynamic cycle. A low boiling-point liquid for example, Freon II, is pumped into a conventional heat exchanger where it is evaporated and slightly superheated with energy from a low-temperature heat source. The vapor is expanded in a rotary gas motor and passes to a condenser from which condensed liquid is pumped back to the evaporator. The net work done by the expansion engine is the difference between the heat added and the heat rejected. For industrial plants, a practical system for recovering waste heat from hot gases at temperatures of 100 to 500°C is being developed. Research is focused on improvements in economy and performance of heat pipe heat exchangers. Development has followed two lines: to reduce the number of pipes in a heat exchanger (typically from 100 to 32), and to increase performance of individual pipes from about 2 kW to 4 kW/unit.

WEIGHT

55443 **Aluminium in the construction of commercial vehicles - economics and energy balance.** Faisst, D. (Alusuisse, Zurich (Switzerland)). *Metall;* **31**: No. 10, 1144-1146(Oct 1977). (In German).

In the last few years, aluminium and aluminium alloys have captured the interest of the vehicle manufacturing industry. Due to their properties - low specific gravity, high strength, good workability into many forms - as well as to modern techniques of jointing and fastening, they offer extremely good possibilities for low-cost constructions. Therefore, among other applications, aluminium is used for a wide range of structures and constructional parts in commercial vehicle engineering.

EMISSION CONTROL

REFER ALSO TO CITATION(S) 55834

55444 (AD-A—050223) **Smoke abatement for dod test cells. Final report 20 Nov 76—30 May 77.** Grems, B.C. III. (Civil and Environmental Engineering Development Office, Tyndall AFB, FL (USA). Detachment 1 (ADTC)). Jul 1977. 108p. (CEEDO-TR—77-40). NTIS PC A06/MF A01.

The Department of Defense owns and operates nearly 200 jet engine test cells. Occasionally, visible exhaust smoke is emitted from these structures. Several pollution control agencies, most notably the State of California, have expressed interest in limiting test cell smoke emissions. A review committee composed of various Air Force and Navy representatives recommended further study of fuel additives as a means of achieving this goal. They recognized additives as the most promising near term solution to the test cell smoke problem. Ferrocene appeared to the best of existing additives. Studies were undertaken to determine the environmental impact, toxicological hazards and engine effects associated with routine ferrocene use. Four types of Navy turbine engines were tested for ten hours each using ferrocene. These tests indicated that engines suffered no harm attributable to ferrocene, but that the additive must be certified for each engine type on an individual basis. Emission measurements made during the tests showed that most pollutants are virtually unchanged in quantity and character by ferrocene use and that particulate matter is actually reduced.

55445 (NTIS/PS—78/0136) **Automobile air pollution: control equipment (citations from the NTIS Data Base). Report for 1970—February 1978.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1978. 186p. NTIS PC N01/MF N01.

The bibliography of Federally-sponsored research cites control equipment and retrofit techniques to control automobile exhaust emissions. The topics include the design and performance of catalytic and thermal reactors, retrofit devices, carburetors, and ignition timing systems. Also covered are studies of the catalysts as well as the equipment regulations that the industry has to follow. (This

updated bibliography contains 181 abstracts, 30 of which are new entries to the previous edition.)

55446 Catalytic device for the catalytic purification of exhaust gases. Neumann, J. (to Volkswagenwerk Aktiengesellschaft). US Patent 4,093,423. 6 Jun 1978. Priority date 7 Dec 1972, German, Federal Republic of (F.R. Germany). 8p.

A catalytic unit for treating gases, particularly exhaust gases of internal combustion engines, containing a monolithic carrier coated with an active catalytic agent, is mounted within a housing by a flexible or elastic, heat-resistant jacket and axially extending slide members interposed between the coated carrier and the housing. The heat-resistant jacket is advantageously prestressed when placed within the housing.

55447 Exhaust gas recirculation apparatus for an internal combustion engine. Yoshida, M. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 4,090,482. 23 May 1978. Priority date 5 Aug 1976, Japan. 6p.

An exhaust gas recirculation apparatus for an internal combustion engine is described that is provided with a vacuum-operated EGR valve having a diaphragm which forms a vacuum control chamber on one side of the diaphragm, which chamber is connected to a vacuum port formed in the engine intake system for transmitting a vacuum signal to the chamber in order to operate the EGR valve for controlling the amount of exhaust gas to be recirculated. The apparatus is further provided with a temperature detecting valve adapted for introducing a limited amount of air through an orifice when the engine is operating under a warm-up condition during which the temperature of the engine is not yet sufficiently increased, so that the amount of the gas recirculated during such an operation is decreased to some extent. The amount of the emission of NO/sub x/ component is slightly increased whereas the amounts of the emissions of CO and HC components are decreased. Therefore, the amount of the emissions of the three major toxic components NO/sub x/, CO and HC are equalized.

NITROGEN OXIDES

55448 Validity of methods of sampling and analyzing nitrogen oxides in the exhaust gases of thermal engines. Charpenet, L.; Charpentier, C. (Univ., Paris). *Entropie;* **14**: No. 80, 12-20(1978). (In French).

The influence of various factors, such as time, pressure, temperature and composition, which affect the measurement of the amounts of nitrogen oxides during the transfer of the gases to the analyzers (by infrared or chemiluminescence) is assessed. The speed constant and the partial orders are obtained for the following reactions: $2\ NO + O_2 = 2\ NO_2$ with mixtures of pure gases treated in conditions identical to those prevailing when the samples of gases from the engines were taken. The results are substantially the same as those of tests on engine exhaust gases. Increases in pressure, transfer time or the amount of oxygen, and a decrease in the temperature of the sampling duct, lead to a drop in the amount of NO and the formation of NO_2. The efficiency of an NO/sub x//NO converter without a catalyst was tested according to the composition and flow-rate of the gases. At a temperature of 1050°C, the conversion of 460 ppM of NO_2, mixed with synthetic air, is quantitative for a flow rate of 30 liters per hour; for an $NO\text{-}NO_2\text{-}O_2\text{-}N_2$ mixture with variable NO and NO_2 concentrations, No_2/NO conversion is complete up to an amount of 360 ppM of NO_2 in the presence of approximately 1500 ppM of NO and variable amounts of O_2. This converter does not induce any oxidative reaction of compounds such as CH_4, CO or H_2 due to the presence of NO in the concentrations normally found; NO_2 is reduced to N_2 by a high NH_3 content in an atmosphere free of O_2.

PARTICULATES

55449 Exhaust gas cleaning device. Akado, H.; Kawashima, Y.; Yamaguchi, A.; Matsuura, H. (to Nippondenson Co., Ltd.). US Patent 4,087,966. 9 May 1978. Priority date 3 May 1973, Japan. 18p.

This specification discloses an exhaust gas cleaning device which is intended for removing harmful substances from exhaust gases of internal combustion engine, especially for removing carbon particles or the like. The device has a body accomodating a filter element adapted to catch the particles in the exhaust gases. The device is attached to the engine as if it were an exhaust manifold so that the clogging particles are conveniently burned by hot gases, whereby the filter element is conveniently recovered.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 55414

55450 (NTIS/PS—78/0235) **Automobile air pollution: automotive fuels (a bibliography with abstracts). Report for 1970-Mar 78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 214p. NTIS PC N01/MF N01.

The use of fuels and fuel additives to reduce pollution from automobiles is covered in this bibliography. The use of methyl alcohol, natural gas, methane, and hydrogen is reported. Improvements to gasoline and its properties which effect air pollution are discussed, along with studies on lead additives. (This updated bibliography contains 209 abstracts, 47 of which are new entries to the previous edition.)

MATERIALS

55451 (BNL—24230) **Small molecule single crystal diffractometry.** Williams, G.J.B. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 24p. (CONF-780355—1). Dep. NTIS, PC A02/MF A01.

From American Crystallographic Association meeting; Norman, OK, USA (20 Mar 1978).

Emphasis is on the use of "standard" diffractometers under the control of "standard computer programs." The factors which affect the various decisions required of an operator are discussed in general terms but few how-to procedures are advocated.

METALS AND ALLOYS

55452 (COO—2975-17) **Advanced gas cooled nuclear reactor materials evaluation and development program. Progress report, July 1, 1977—September 30, 1977.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 14 Nov 1977. Contract EY-76-C-02-2975. 81p. Dep. NTIS, PC A05/MF A01.

Work covered includes an updated listing of the alloys selected for the screening tests, plus complete test specimen matrices for the screening program. The present design and construction status of the simulated reactor helium loops and testing and analysis facilities and equipment are discussed. Also covered are the loading matrices for the screening creep tests.

55453 (NTIS/PS—78/0198) **Superalloys. Volume 1. 1964—1976 (citations from the NTIS data base). Report for 1964—76.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 242p. NTIS PC N01/MF N01.

Federally-funded research studies on coatings, nuclear materials, testing, fabrication, corrosion, and mechanical properties of superalloys are cited. Research on composites from superalloys are included. (This updated bibliography contains 237 abstracts, none of which are new entries to the previous edition.)

55454 (NTIS/PS—78/0199) **Superalloys. Volume 2. 1977-February 1978 (citations from the NTIS data base). Report for 1977—Feb 78.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 92p. NTIS PC N01/MF N01.

Federally-funded research on cobalt- and nickel-based superalloys is cited. Casting and powder metallurgy of these alloys are covered. Properties such as heat resistance, corrosion resistance, microstructure, fracture, and creep are described. The use of these materials in nuclear reactors, gas turbine parts, and high-temperature equipment is a major part of this compilation. (This updated bibliography contains 87 abstracts, 69 of which are new entries to the previous edition.)

55455 (NTIS/PS—78/0201) **Superalloys. Volume 3. March 1977—February 1978 (citations from the Engineering Index data base). Report for Mar 77—Feb 78.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 178p. NTIS PC N01/MF N01.

Worldwide research is cited on cobalt-, iron-, and nickel-based superalloys. The manufacture, melting, casting, powder metallurgy, forging, and welding of these alloys are covered. Studies on corrosion, high- and low-temperature properties, physical and mechanical properties of these materials are included. Applications discussed are nuclear reactors, gas turbines, superconducting machinery, and heat exchangers. (This updated bibliography contains 171 abstracts, all of which are new entries to the previous edition.)

55456 Reactive plasma cleaning of metals. Kominiak, G.J.; Mattox, D.M. (Sandia Labs., Albuquerque, NM). *Thin Solid Films;* **40**: 141-148(1977).

Reactive plasmas formed in an r.f. discharge are effective in removing contaminants and barrier layers from a variety of metals. Reactive d.c. discharges are ineffective. A mixture of argon (90 to 99%) with a reactive gas or a gas which will decompose to a

reactive species in the discharge was used in the r.f. reactive plasmas. A soft x-ray appearance potential spectrometer was used for in situ surface analysis to evaluate the surface cleaning. Carbon-containing gases, such as those used in reactive plasma etching, left a carbon residue on the surface. Oxygen additions to the reactive plasma, such as are used in reactive etching, prevented cleaning of the metal surfaces. Reactive plasmas containing hydrochloric acid were the most effective. Reactive plasma cleaning in Ar—HCl was as effective as r.f. sputter cleaning and could be accomplished at much lower power levels. For example, reactive plasma cleaning of titanium was accomplished in 90 min using 500 V r.f. and 30 W in an Ar-5% HCl plasma. Similar r.f. sputter cleaning required 90 min at 2 kV r.f. and 600 W in Ar. It is proposed that the reactive species reacts with the surface, forming compounds which are more easily volatilized or sputtered.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 55063

55457 (AD-A—050055) **Metastable metallic superconductors with high transition temperatures and composite superconductors. Final report 1 Jan 74—31 Dec 77.** Gavaler, J.R.; Daniel, M.R. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 31 Dec 1977. Contract F44620-74-C-0042. 22p. NTIS PC A02/MF A01.

Chemical vapor deposition (CVD) was found to be a practical method for preparing large quantities of Nb-Ge. The fabrication of Nb-Ge multifilamentary and tape conductors by this method was shown to be feasible. CVD Nb-Ge had critical temperatures and upper critical fields comparable to the sputtered material. Critical-current densities were lower. Second-phase doping was shown effective toward improving current-carrying capacity. A new Nb-Ge growth method (reactive sputtering of niobium in Argon/Germane) was demonstrated and its applicability for use in a magnetron sputtering system evaluated. A study of the effect of impurities (oxygen, nitrogen and silicon) on sputtered Nb-Ge films indicated that each of these impurities can stabilize the high-critical temperature metastable A15 phase. An investigation of the bronze diffusion process illustrated why A15 Nb-Ge cannot readily be made by this method. The formation of A15 Nb-Ga by bronze diffusion was achieved. The preparation of superconducting niobium and A15 structure Nb-Sn was accomplished by liquid sodium reduction of the halides. The anomalously high upper critical field of sputtered NbN film was shown to be due to a surface critical field.

55458 (UCRL—81201) **Ultrasonic measurements of thin metallic interfacial regions.** Maxfield, B.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 May 1978. Contract W-7405-ENG-48. 10p. (CONF-780650—3). Dep. NTIS, PC A02/MF A01.

From 1. symposium on ultrasonic materials characterization; Gaithersburg, MD, USA (7 Jun 1978).

A typical braze joint consists of a metallic region which wets the surface of the two metals being joined, thereby achieving a bond of good mechanical integrity. An ultrasonic signal reflected from this bond can normally distinguish between bonded and unbonded regions but gives little information about the strength of such a region. For some brazes (and other bonding operations), there is a good correlation between thickness and bond strength in that a bond falling within a specified thickness range can be shown to perform adequately while both thinner and thicker bonds exhibit degraded performance. For a 50 μm thick braze, ultrasonic reflections are "separated" by roughly 16 nsec. For any real transducer, this means that there is significant overlap of the front and back surface reflections. We have studied a model system consisting of thin (12 to 90 μm) aluminum bonded to the back surface beryllium. By computer fitting the time dependence of the elastic disturbance reflected from the beryllium-aluminum region to a two-plane wave reflector model and allowing for multiple reflection, we correctly predict the interface separations. Details of the data acquisition and analysis, including the fitting procedure and an error analysis, are given. Accuracy depends upon the separation; a 50 μm thick (2 mil) bond can be determined with an accuracy of about 20%. The thickness of highly graded joins, consisting of two different braze materials, can be determined with an accuracy of about 30%.

55459 Investigations into methods of improving the weldability of type GGG-NiCr 20 2 austenitic cast iron. Stephenson, N.; Strassburg, F.W. *Schweissen Schneiden;* **30**: No. 2, 48-53(Feb 1978). (In German).

Investigations were carried out with the object of improving the weldability properties of type GGG-NiCr 20 2 austenitic cast iron containing spheroid graphite and in particular of improving its resistance to the formation of thermal cracks in the heat affected zone of the weld. This can be achieved by alloying with niobium and by balancing and controlling the respective silicon, magnesium, phosphorus and niobium contents. These elements influence the structure of the material during the solidification phase and the subsequent re-heating which takes place during the process of welding. The quality of the weld joint is greatly influenced by the wall thickness of the material being welded, by the type of filler materials used and also by the pre- and post-welding heat treatment given. The modified type GGG-NiCrNb 20 2 material can be welded without there being any risk of thermal cracks forming.

55460 High strength ferritic alloy. Hagel, W.C.; Smidt, F.A.; Korenko, M.K. (to Energy Research and Development Administration). US Patent 4,049,431. 20 Sep 1977. Filed date 30 Sep 1976. 8p. PAT-APPL-728,361.

A high-strength ferritic alloy useful for fast reactor duct and cladding applications wherein an iron base contains from about 9% to about 13% by weight chromium, from about 4% to about 8% by weight molybdenum, from about 0.2% to about 0.8% by weight niobium, from about 0.1% to about 0.3% by weight vanadium, from about 0.2% to about 0.8% by weight silicon, from about 0.2% to about 0.8% by weight manganese, a maximum of about 0.05% by weight nitrogen, a maximum of about 0.02% by weight sulfur, a maximum of about 0.02% by weight phosphorous, and from about 0.04% to about 0.12% by weight carbon.

55461 High strength ferritic alloy-D53. Hagel, W.C.; Smidt, F.A.; Korenko, M.K. (to Energy Research and Development Administration). US Patent 4,049,432. 20 Sep 1977. Filed date 30 Sep 1976. 6p.

PAT-APPL-728,362.

A high strength ferritic alloy is described having from about 0.2% to about 0.8% by weight nickel, from about 2.5% to about 3.6% by weight chromium, from about 2.5% to about 3.5% by weight molybdenum, from about 0.1% to about 0.5% by weight vanadium, from about 0.1% to about 0.5% by weight silicon, from about 0.1% to about 0.6% by weight manganese, from about 0.12% to about 0.20% by weight carbon, from about 0.02% to about 0.1% by weight boron, a maximum of about 0.05% by weight nitrogen, a maximum of about 0.02% by weight phosphorous, a maximum of about 0.02% by weight sulfur, and the balance iron.

55462 Method of fabricating composite superconducting wire. Strauss, B.P. (to Energy Research and Development Administration). US Patent 4,044,457. 30 Aug 1977. Filed date 1 Apr 1976. 6p. PAT-APPL-672,575.

An improvement in the method for preparing composite rods of superconducting alloy and normal metal from which multifilament composite superconducting wire is fabricated by bending longitudinally a strip of normal metal around a rod of superconductor alloy and welding the edges to form the composite rod. After the rods have preferably been provided with a hexagonal cross-sectional shape, a plurality of the rods are stacked into a normal metal extrusion can, sealed and worked to reduce the cross-sectional size and form multifilament wire. Diffusion barriers and high-electrical resistance barriers can easily be introduced into the wire by plating or otherwise coating the faces of the normal metal strip with appropriate materials.

55463 Process for ductilizing tungsten and tungsten base composites. Zukas, E.G. (to Dept. of Energy). US Patent Application 773,362. 1 Mar 1977. 15p.

A method of coating the surface of either tungsten or tungsten base composite with a metal which is ductile at low temperatures, and heat treating the coated part to allow diffusion to form a metallurgical bond between the tungsten-composite and coating. The thickness of the coating is not critical as long as there is adequate thickness which retains the properties of the coating, approximately 0.05 mm.

55464 Standard test method for quenching time of heat-treating fluids (magnetic quenchometer method). *Annu. Book ASTM Stand.;* No. 25, 291-297(1977).

ANSI/ASTM-D—3520-76.

A method using a Magnetic Quenchometer is described for evaluating the quenching speed characteristics of fluids used in quenching of metals. The time is determined for cooling a chromized nickel ball from approximately 885°C to approximately 354°C when quenched in 200 ml of the test fluid in a metal beaker at 21 to 27°C. The quenching time is recorded by a digital timer which is energized by a photoelectric cell from light produced by the ball at 885°C and which is stopped when the ball becomes magnetized and is attracted to the side of the beaker by a magnet to trip a relay stopping the timer.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 55485, 55497

55465 (AD-A—050473) **Mechanical behavior of titanium alloys (formation behavior of alpha/beta interface phase in Ti6Al—4V. Technical report Feb 76—Feb 77.** Rhodes, C.G.; Paton, N.E. (Rockwell

International Corp., Thousand Oaks, CA (USA). Science Center). 13 Jan 1978. Contract N00014-76-C-0598. 32p. (SC—5056-1TR). NTIS PC A03/MF A01.

The conditions for formation of the interface phase, or interfacial layer, in Ti-6Al-4V have been studied systematically. The interface phase does not grow during isothermal treatments, but rather only during cooling from elevated temperatures to about 650°C. The width of the interfacial layer is a function of the cooling rate, having a maximum of about 4000A at 28°C/h. The interface phase forms initially with an fcc structure which subsequently transforms to hcp alpha phase. A theoretical description of the mechanisms of interface phase formation is presented.

55466 Observations of pretransformation lattice instability in near-equiatomic NiTi alloy. Aboelfotoh, M.O.; Aboelfotoh, H.A.; Washburn, J. (IBM Corporation, System Communications Division, Kingston, New York 12401). *J. Appl. Phys.;* **49**: No. 10, 5230-5232(Oct 1978).

Observations were made on the pretransformation effects in near-equiatomic NiTi alloy using the technique of transmission electron microscopy and diffraction. The pretransformation effects are discussed in terms of lattice displacement waves arising from the instability of the B2 lattice.

55467 Thermodynamic analysis of phase relationships in the iron—copper system. Kubaschewski, O. (Technische Hochschule, Aachen); Smith, J.F.; Bailey, D.M. *Z. Metallkd.;* **68**: No. 7, 495-499(1977).

Available thermodynamic data have been perused to develop a set of analytical expressions which describe the Gibbs energies of phase formation for the liquid, the fcc and bcc phases in the Fe-Cu system as functions of composition and temperature. These functions predict phase equilibria in close agreement with the experimental temperature-composition diagram.

55468 Basic physics of one-dimensional metals. Emery, V.J. (Brookhaven National Lab., Upton, NY). pp 1-23 of Chemistry and physics of one-dimensional metals. Keller, H.J. (ed.). New York; Plenum Publishing Corp. (1977).

A qualitative description of the physical concepts of one-dimensional metals is presented. Topics included are: one-dimensional systems; interchain coupling and phase transitions; and lattice distortions and phonon anomalies. (GHT)

55469 Exchange vs crystal fields in Gd—Pr single crystal alloys. Legvold, S.; Burgardt, P.; Beaudry, B.J. (Ames Lab., IA). pp 340-344 of Crystal field effects in metals and alloys. Furrer, A. (ed.). New York; Plenum Publishing Corp. (1977).

The saturation magnetic moment of a hcp single crystal of $Gd_{0.91}Pr_{0.09}$ was measured and a value of 6.63 Bohr magnetons per atom was obtained. If a magnetic moment of 3.2 μ/sub B/ per Pr atom and 7.55 μ/sub B/ per Gd atom and normal spin exchange coupling so as to have antiparallel moments are assumed, a theoretical value of 6.60 Bohr magnetons is obtained in excellent agreement with the observed value. This demonstrates that the exchange field dominates the hexagonal crystal field in this sample. The sample exhibited strong magnetic anisotropy which corroborates our interpretation of the results.

55470 Spiral growth of Pb—Sn eutectic alloys. Mourer, D.P.; Verhoeven, J.D. (Ames Lab., IA). *J. Cryst. Growth;* **37**: 197-203(1977).

Directionally solidified Pb—Sn eutectic alloys have been observed to display four different crystallographic relationships. The present study determined that only one of these crystallographies exhibits the spiral growth phenomenon. The rate of spiralling was shown to increase strongly with solidification rate; its dependence upon temperature gradient was not reproducible, but it was found that the spiral rate did not decrease with increasing gradient as previous investigators had postulated.

55471 Microwave resistivities of some singlet-ground-state paramagnetic systems. Sugawara, K. (Case Western Reserve Univ., Cleveland); Huang, C.Y.; Chu, C.W.; Cooper, B.R. *Solid State Commun.;* **21**: No. 2, 189-192(1977).

Microwave resistivities of the singlet-ground-state systems TmX, PrX (X = N, P, As, Sb, and Bi) and Pr_3Tl, have been measured. The crystal-field splittings of Tm^{3+} and Pr^{3+} in these systems have been obtained by comparing our resistivity data with Hirst's first-order scattering theory. The splittings obtained in this fashion are in good agreement with those measured by neutron scattering and EPR. We discuss the absence of the maximum in resistivity with variation of temperature expected from the Kondo sideband (second-order inelastic scattering) mechanism.

55472 Electronic structure, field-induced magnetization density and neutron magnetic form factor of palladium. Watson-Yang, T.J. (Northwestern Univ., Evanston, IL); Harmon, B.N.; Freeman, A.J. *J. Magn. Magn. Mater.;* **2**: 334-344(1976).

The magnetic field induced magnetization density and neutron magnetic form factor of Pd metal is obtained from an ab initio APW energy band study of its electronic structure and properties. The magnetization consists of the spin density calculated for states on the Fermi surface and a much smaller orbital contribution. The solid state wavefunctions are found to yield a spatial localization of the spin density which is greater than that of the very contracted Hartree—Fock density of the free Pd^{2+} ion. The theoretical magnetic form factor, which is dominated by the contribution of the fifth band, is found to be in excellent agreement with the measurements of Cable, Wollan, Felcher, Brun and Hornfeldt.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 54991, 55008, 55125, 55460, 55461

55473 (AD-A—049200) **Fatigue crack propagation in titanium alloys. Annual report, 1 July 1976—30 September 1977.** McEvily, A.J. (Connecticut Univ., Storrs (USA). Dept. of Metallurgy). Nov 1977. 7p. (UC-MET—5-1977). NTIS PC A02/MF A01.

This Annual Report covers the period Aug. 1, 1976 through Sept. 30, 1977, and deals with the topics of fatigue crack initiation and growth in Ti-6Al-4V forging alloy. Subsurface crack initiation has been related to the presence of severe dislocation pile-ups and perhaps to the influence of internal hydrogen. In the fatigue crack growth progress it has been shown that different mechanism are operative in various regions of the da/dN versus delta K plot. The retardation effect associated with overload has been shown to be primarily a surface-related effect due to the higher degree of crack closure which exists in the surface regions of a specimen. (Author)

55474 (EPRI-NP—526(Vol.2)) **Transient deformation properties of Zircaloy for LOCA simulation. Final report, Volume 2.** Hann, C.R.; Mohr, C.L.; Busness, K.M.; Olson, N.J.; Reich, F.R.; Stewart, K.B. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1978. 279p. Dep. NTIS, PC A13/MF A01.

The creep/creep rupture anisotropic properties of Zircaloy were determined and compared by analytical techniques with ramp-pressure and ramp-temperature test results. Tests were performed over the temperature range of 600°F (589°K) to 2200°F (1477°K), with the emphasis on the 800°F (700°K) to 2000°F (1366°K) temperature levels in low pressure air (6.5×10^{-5} atm) and in a 1 atm mixture of 20 percent oxygen, 80 percent argon. Stress levels of 60 to 95 percent of the ultimate tensile stress were used for the majority of the tests at each of the temperature levels tested, with selected tests performed as low as 30 percent of the ultimate tensile stress. Biaxial and uniaxial testing modes were used to evaluate the anisotropic deformation behavior. The combination of test results and predictive-analysis techniques developed as part of this program make it possible to predict the transient deformation of reactor fuel cladding during simulated LOCA conditions. Results include creep/creep rupture strain numerical constitutive relationships out to 120 seconds, computer codes and ramp test data.

55475 (NUREG—0351) **Annual report of contract research for the Metallurgy and Materials Research Branch, Division of Reactor Safety Research, Fiscal Year 1977.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). May 1978. 353p. NTIS $12.50.

Research is reported in the areas of: fracture and structural mechanics; non-destructive testing; steam generator integrity and corrosion; pressure vessel surveillance dosimetry and piping system analysis. (GHT)

55476 (NUREG/CR—0079) **Critical experiments, measurements, and analyses to establish a crack arrest methodology for nuclear pressure vessel steels. Quarterly report, January—March 1977.** Hahn, G.T. (Battelle Columbus Labs., OH (USA)). Sep 1977. 113p. Dep. NTIS, MF A01.

Portions of document are illegible.

Static and dynamic, two-dimensional finite difference analyses of the compact (CT) tension specimen are described. The static analyses define the specimen compliance and relation between the displacement of the load point and that existing at the end of the specimen. The dynamic analyses define the relations among the K/sub Q//K/sub ID/-ratio, the crack advance, and the average crack velocity for a wide range of run-arrest events in ordinary- and duplex-CT specimens. Results of instrumented run-arrest experiments in CT-specimens of A533B steel are presented which define relations between crack advance and crack velocity and effects of load train compliance. Load-train compliance measurements reveal that significant amounts of "excess" strain energy are stored in the stressed regions of the wedge, pins and specimen adjacent to the contact areas. This "excess" energy, which is transmitted to or redistributed within the test specimen while the crack is propagating, arrives too late to affect the average velocity, but does cause the crack to propagate farther. The K/sub ID/-valves inferred from the

velocity measurements agree with the fast-fracture-toughness values previously obtained for the same steel from more deeply side grooved DCB-specimens. A formal, ASTM-type specification for a "Proposed Tentative Method of Test for Fast Fracture Toughness and Crack Arrest Toughness" is presented. The method employs a dynamic interpretation, but requires no dynamic measurements. A strain gage-based crack velocity measuring technique that can be used at elevated temperatures is evaluated. Finally, four preliminary tests of the ORNL A533B "quenched" material that were carried out at 93°C and 149°C are described. The response of the duplex-specimens appears to be complicated by the formulation of a tough-heat affected zone adjacent to the weld in the test material.

55477 (ORNL—5374) **High-Temperature Structural Design Program. Semiannual progress report for period ending December 31, 1977.** Corum, J.M.; Pugh, C.E. (Oak Ridge National Lab., TN (USA)). May 1978. Contract W-7405-ENG-26. 234p. AT.

Major study areas include: constitutive equations for inelastic design analysis; inelastic structural tests and analyses; design criteria and rules for time-dependent deformation and failure; simplified design methods; thermal ratchetting tests; and structural design methods for weldments. (GHT)

55478 (UCRL—51782(Pt.1)) **Behavior of porous beryllium under thermomechanical loading. Part 1. Summary of results.** Isbell, W.M.; Walton, O.R.; Ree, F.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Dec 1977. Contract W-7405-ENG-48. 58p. Dep. NTIS, PC A04/MF A01.

The complex mechanical response of plasma-sprayed beryllium with 10 to 15% initial porosity to various static and dynamic loading conditions was studied. This combined experimental-theoretical program resulted in a calculational model capable of accurately predicting the propagation and attenuation of stress waves in porous beryllium. The program also included development of improved measuring techniques for both gas-gun and electron-beam experiments involving porous materials. Porous beryllium samples in the as-sprayed condition and after sintering were used in a comprehensive set of static (0 to 4 GPa) and dynamic (0 to 33 GPa) mechanical loading experiments. Microstructural analyses of the effects of pressure and specimen preparation on grain size, grain morphology, and void distribution were performed. Both types of porous beryllium were also exposed to high-energy, pulsed electron beams to determine the effects of rapid heating. The results of the experiments guided a modeling effort which added several new features to previous porous-material models, including deviatoric stresses, porosity-dependent pore closure relaxation time, elastic-plastic reopening of pores, and improved compaction functions. Wave profiles generated in plate-impact experiments were used to test the accuracy of the calculational model whose input parameters were determined from other experimental conditions. Excellent agreement was achieved between the predicted and experimental wave profiles. The use of thin layers of porous materials as protection against high-intensity short-duration shock waves arising from either mechanical impact or sudden heating are discussed.

55479 (UCRL—80491) **Plastic-strain, mean-stress criterion for ductile fracture.** Norris, D.M. Jr.; Reaugh, J.E.; Moran, B.; Quinones, D.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Dec 1977. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

We describe a computer model for predicting ductile-fracture initiation and propagation. The model is based on plastic strain. Fracture starts or a crack extends when the integrated product of the equivalent plastic-strain increment and a function of the mean stress exceeds a critical value over a critical length. This critical length is characteristic of the microstructure of the material. The computer fracture model is calibrated by computer simulation of simple and notched round-bar tension tests and a precracked compact tension test. The model is then used to predict fracture initiation and propagation in the standard Charpy V-notch specimen. The computed results are compared with experiments. The model predicts fracture toughness from tests of standard surveillance specimens from nuclear-reactor pressure vessels and can be applied to fracture calculations for these vessels.

55480 **Ultrahigh strength steels having improved fracture toughness.** Parker, E.R.; Zachay, V.F.; Bhat, M.S. (to Dept. of Energy). US Patent Application 773,361. 1 Mar 1977. 9p.

An ultrahigh strength steel material of improved fracture toughness having a composition consisting essentially of about 1—2 wt. % aluminum, about 1—2 wt. % silicon, about 0.3—0.5 wt. % carbon, an effective amount of hardenability improving element(s), and the balance iron.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 55405, 55457, 55471, 55524, 55538

55481 (AD-A—049326) **Angular-resolved electron emission studies of microwave materials. Final scientific report, 1 July 1975—30 June 1977.** Lapeyre, G.J. (Montana State Univ., Bozeman (USA). Dept. of Physics). 30 Jun 1977. 18p. NTIS PC A02/MF A01.

The purpose of our program is to investigate the electronic properties of bulk solids, surfaces of solids, and adsorbed molecules on solid surfaces using the newly-developed method of polarization-dependent angle-resolved ultraviolet photoemission spectroscopy (PARUPS). The program utilizes the unique properties of synchrotron radiation emitted from the Wisconsin storage ring which forms an intense continuum which extends well past 200 eV in energy. The portion of this continuum we have used depends on our monochromator and extends from 6 eV to about 40 eV. It is possible to take data at any selected photon energy in this range, as well as to do so while varying the photon energy continuously. The radiation is linearly polarized so it is possible to study photoemission effects which depend on the orientation of the polarization vector with respect to the crystal axes of the sample. Such data one to draw inferences about the electronic structure, wave function symmetry and, in certain cases, the orientation of adsorbed molecules.

55482 (COO—2679-21) **Effect of surface condition on diffusion in thin films at low temperatures. Report No. 3026.** Hwang, J.C.M.; Ho, P.S.; Balluffi, R.W. (IBM Watson Research Center, Yorktown Heights, NY (USA); Cornell Univ., Ithaca, NY (USA)). May 1978. Contract EY-76-S-02-2679. 13p. Dep. NTIS, PC A02/MF A01.

The effect of surface condition on the out-diffusion of atoms through a thin film to the free surface has been analyzed by considering the coupling between grain boundary diffusion and surface diffusion. It is demonstrated that under certain circumstances, the surface diffusion rate can have a large effect on the measured rate of diffusion through the thin film. In the analysis for the cases involving out-diffusion, the surface is treated as a sink of finite capacity and the saturation level of material accumulation at the surface is discussed in terms of a surface segregation ratio. This analysis can qualitatively explain some of the recent experimental observations on the effect of the annealing ambient on out-diffusion. The opposite, but similar, problem of the effect of the source surface condition on the rate of in-diffusion from the surface has also been discussed.

55483 (COO—4387-1) **Theoretical studies of chemisorption on transition metal surfaces: interaction of hydrogen with titanium. Progress report, June 1, 1977—May 31, 1978.** Whitten, J.L.; Doll, J.D. (State Univ. of New York, Stony Brook (USA)). Apr 1978. Contract EG-77-S-02-4387. 29p. Dep. NTIS, MF A01.

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The research is concerned with the theory of chemisorption of molecules on solid surfaces, with applications to the hydrogen-titanium system. The ab initio computational formulation is based on two main ideas: (1) the application of a recently developed approximation technique which utilizes error bounds on electrostatic interactions to achieve a major organizational simplification of the problem, and (2) the definition of a local (surface) region plus the adsorbate in which the partitioning is accomplished by an orbital localization scheme. The first phase of research was concerned primarily with the implementation of basic computational techniques including the approximation of electrostatic interactions, development of multipole expansions, and the direct approximation of the electron density and first order density matrix derived from a given wavefunction based on error bound criteria. A pseudopotential method was developed for the approximation of atomic cores. Calculations on Ti atom, TiH, Ti/sub n/-linear (n = 1-10), Ti_6-planar, and Ti_6H systems were carried out to test the computational methods and to examine the concept of a local (surface) region defined by the localization transformation. In all linear chain and Ti_6-planar cases, the exchange maximization with a designated site gave well localized orbitals, and in the linear chains, the localized orbitals were found to be invariant for n greater than or equal to 4.

55484 (JEN—389) **Physical properties of liquid sodium.** Alberdi Primicia, J.; Martinez Piquer, T.A. (Junta de Energia Nuclear, Madrid (Spain)). 1977. 35p. (In Spanish). Dep. NTIS (US Sales Only), PC A03/MF A01.

Molten sodium has been the more accepted coolant for the first generation of FBR; for this reason the knowledge of its technology is needed for the development of the next LMFBR. A series of data necessary for designing liquid sodium systems is given. Tables and graphs about the most important physical properties of sodium between 1200-1400°C are gathered. The results have been obtained from equations that relate the properties with temperature using a Fortran IV program.

55485 (LBL—7698) **Microstructure and magnetic properties of Fe—Cr—15 wt % Co alloys with and without V, V + Ti additions.** Belli, Y. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 80p. Dep. NTIS, PC A05/MF A01.

Thesis.

The relationship between microstructure and magnetic properties of Fe—28Cr—15Co, Fe—23Cr—15Co—5V and Fe—23Cr—15Co—3V—2Ti (wt.%) alloys have been investigated by transmission electron microscopy, and Lorentz microscopy. The heat treatments adopted for the present investigation are (1) isothermal aging, (2) thermomagnetic treatment (TMT) + step-aging, and (3) TMT + continuous cooling. The morphology of the microstructure is very much affected by the aging temperature. Thermomagnetic treatment is very effective in elongation of the Fe—Co rich (α_1) phase particles, and the elongation of the α_1 phase particles is independent of crystal orientation. Step-aging and continuous cooling produce optimum magnetic properties. During step-aging microstructural features remain essentially unchanged, and the composition difference of the two phases increases. Continuous cooling is an alternative way to produce optimum magnetic properties. Microstructural features are almost independent of the cooling rate, and then they must be developed mainly by the TMT. Lorentz microscopy results show that the domain walls tend to lie in the weakly ferromagnetic matrix phase and are pinned by Fe—Co rich (α_1) phase particles as pinning sites (as opposed to the supposed single domain hardening). This observation suggests that the magnetization mechanism is governed by domain wall pinning. Magnetic domains are narrower in optimally treated alloys, and elongated parallel to the applied field. The anisotropy induced during TMT increases during step-aging or continuous cooling. The three alloys produce similar magnetic properties. However, due to their more facilitated heat treatments the alloys containing V and V + Ti additions would be of more industrial interest.

55486 Neutron incoherent elastic scattering study of the temperature dependence of the Debye-Waller exponent in vanadium. Kamal, M.; Malik, S.S.; Rorer, D. (Physics Department, University of Rhode Island, Kingston, Rhode Island 02881). *Phys. Rev., B;* **18**: No. 4, 1609-1617(15 Aug 1978).

Incoherent elastic neutron scattering from vanadium has been employed to determine the mean-squared displacement "$< u^2 >$/sub T/" through the Debye-Waller exponent for the temperature range between 4.2 and 296 K. Significant corrections to the scattering data arise from (i) primary scattering due to the cylindrical shape of the vanadium sample and (ii) inelastic scattering. Calculations for $< u^2 >$ /sub T/ employed our own experimental values of g (ϵ) at room temperature. Experimental values of $< u^2 >$ /sub T/ disagree with calculations if one assumes g (ϵ) to be independent of temperature. Substantial hardening of the phonon spectrum is required to account for the low-temperature experimental values of $< u^2 >$. The results suggest that additional work on the temperature dependence of g (ϵ), especially for the low-energy phonons, is needed.

55487 Self-consistent studies of d holes and d-band narrowing in a Cu (001) monolayer. Wang, C.S.; Freeman, A.J. (Department of Physics and Astronomy and Materials Research Center, Northwestern University, Evanston, Illinois 60201). *Phys. Rev., B;* **18**: No. 4, 1714-1717(15 Aug 1978).

We report results of the first ab initio self-consistent (SC) calculations of the electronic structure of a Cu (001) monolayer using the newly developed numerical-basis-set linear-combination-of-atomic-orbitals method for thin films. The d holes found in the non-SC calculations of Cooper, and in those reported here, are not found to exist when the calculations are carried to self-consistency. The calculated narrowing of the d-band width of the monolayer relative to the bulk is consistent with several photoemission experiments.

55488 Determination of the energy gaps in metals by an optical method. Mash, E.D.; Motulevich, G.P.; Shubin, A.A. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 2, 75-79(20 Jan 1978).

A method is proposed for separating the interband-conduction bands, and is based on the use of the analytic properties of the complex dielectric constant connected with the interband transitions. The method makes it possible to determine the number of interband conduction bands and to obtain the position of the maxima of the individual bands, and thereby determine the energy gaps in metals. The method is used to analyze the experimental results for vanadium.

55489 Forbidden reflections in the superconducting compound V_3Ge. Kodess, B.N.; Butman, L.A.; Porai-Koshits, M.A. (Scientific-Research Institute for Nuclear Physics, M. V. Lomonosov Moscow State University). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 1, 54-55(Jan 1978).

An x-ray study was made of V_3Ge in the A15 structural type. The anharmonicty constants were measured.

55490 Positron-annihilation data tables Table III. Doppler broadening of annihilation-radiation line shape. Singru, R.M.; Lal, K.B.; Tao, S.J.; Lambrecht, R.M. (Department of Physics, Indian Institute of Technology, Kanpur, India). *At. Data Nucl. Data Tables;* **20**: No. 6, 475-501(Dec 1977).

Positron-annihilation experimental data found by the method of Doppler broadening of annihilation-radiation line shape are summarized here. The literature has been covered from 1970 to 1976.

55491 Magnetic properties and magnetic transitions in rare-earth intermetallic compounds (Tb/sub 1-x/Y/sub x/)$_3$Co. Deryagin, A.V.; Baronov, N.V.; Reimer, V.A. (Urals State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 731-736(Oct 1977).

The concentration dependence of the crystal lattice parameters, of the magnetic transition temperatures, of the molecular magnetic moment, of the effective magnetic anisotropy constant, and of the hysteretic magnetic properties is investigated for single crystals of the rare-earth intermetallic compounds (Tb/sub 1-x/Y/sub x/)$_3$Co ($0 <$ or $= x <$ or $= 1$), in which the effective magnetic anisotropy field is comparable with or larger than the effective exchange-interaction field. A qualitative explanation of the observed regularities is given. Magnetically hard single crystals, with a gigantic value of the maximum energy product (up to 100 million G-Oe), are obtained.

55492 Dechanneling of protons in single-crystal tungsten. Roslyakov, V.I.; Rudnev, A.S.; Sirotinin, E.I.; Tulinov, A.F. (Nuclear Physics Research Institute of the Moscow State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 781-784(Oct 1977).

The energy spectra of the backward scattering of protons with $E_0 = 6.3$ MeV were used to determine the integral dechanneling functions for the axial (<111>, <100>, <110>) and planar ({110}) channels of the tungsten crystal at temperatures 293, 620, and 850 K. The energy scale was converted into a depth scale by using the previously obtained [A. S. Rudnev et al., Phys. Status Solidi A 35, K23 (1976)] values of the energy losses of the channeled particles. It is shown that the principal dechanneling mechanism at depths $<$ or ≈ 20 μm is scattering due to thermal vibrations of the atoms in the crystal lattice.

55493 Nonlinear Cyclotron absorption of a hole doppleron in cadmium. Voloshin, I.F.; Bugal'ter, G.A.; Demikhovskii, V.Y.; Fisher, L.M.; Yudin, V.A. (V. I. Lenin All-Union Electrotechnical Institute). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 790-797(Oct 1977).

We investigated experimentally the nonlinear behavior of the impedance of a cadmium plate in the region of existence of the hole doppleron. It is shown theoretically that this phenomenon can be attributed to nonlinear cyclotron absorption of the wave in the metal. A theory of nonlinear cyclotron absorption of a hole doppleron in cadmium is constructed. The nonlinearity is due to the influence of the wave magnetic field H that alters the trajectories of the resonant electrons responsible for the cyclotron asorption. The Lorentz force connected with the field H modulates the particle velocity along the magnetic field at a characteristic frequency ω_0 proportional to the square root of the wave amplitude. The modulation of the longitudinal particle velocity leads to violation of the condition of their resonant interaction with the wave, as a result of which the absorption coefficient decreases. The nonlinearity is significant when the frequency ω_0 is large compared with the electron-collision frequency. A decrease of the cyclotron absorption changes radically the picture of the surface-impedance oscillations of the plate in the magnetic field. We studied in the experiment the influence of the temperature, of the angle of inclination of the magnetic field, and of the frequency on the nonlinear-effect threshold field that separates the regions of linear and nonlinear behavior of the sample impedance. The measurement results are in qualitative agreement with the conclusions of the theory.

55494 Magnetic, magnetoelastic, and electric properties of single-crystal terbium-gadolinium alloys. Nikitin, S.A.; Sheludko, N.A.; Posyado, V.P.; Chuprikov, G.E. (Moscow State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 3, 530-534(Sep 1977).

The concentration dependences of the magnetic, magnetoelastic, and electric properties of single-crystal terbium-gadolinium alloys have been investigated. A restructuring of the Fermi surface has been observed at small gadolinium contents in the alloys. It is shown on the basis of the experimental data on the anisotropy of the paramagnetic Curie points that the magnetic anisotropy in the terbium-gadolinium alloys is due mainly to the single-ion crystal-field mechanism.

55495 Pu—Zr alloy high-temperature activation-measurement foil. McCuaig, F.D. (to Energy Research and Development Administration). US Patent 4,039,378. 2 Aug 1977. Filed date 26 Oct 1976. 6p.

PAT-APPL-735,566.

A nuclear reactor fuel alloy consists essentially of from slightly greater than 7 to about 4 w/o zirconium, balance plutonium, and is characterized in that the alloy is castable and is rollable to thin foils. A preferred embodiment of about 7 w/o zirconium, balance plutonium, has a melting point substantially above the melting point of plutonium, is rollable to foils as thin as 0.0005 inch thick, and is

compatible with cladding material when repeatedly cycled to temperatures above 650°C. Neutron flux densities across a reactor core can be determined with a high-temperature activation-measurement foil which consists of a fuel alloy foil core sandwiched and sealed between two cladding material jackets, the fuel alloy foil core being a 7 w/o zirconium, plutonium foil which is from 0.005 to 0.0005 inch thick.

55496 Magnetic breakdown and thermoelectric power in niobium. Alekseevskii, N.E.; Bertel, K.h.; Nizhankovskii, V.I.; Glinski, M.; Fuchs, G. (International Laboratory for Strong Magnetic Fields and Low Temperatures, Wroclaw, Poland). *Sov. Phys. - JETP (Engl. Transl.);* 46: No. 2, 366-369(Aug 1977).

We measured the transverse magnetoresistance and thermoelectric power of a niobium sample with orientation [001] in fields up to 150 kOe. A large thermoelectric-power signal and its oscillations were observed at H parallel [110]. Coherent magnetic breakdown in the region of the conical point contacts located on the ΓP symmetry lines, is invoked to explain the results.

55497 Anomalous pretransformation diffusion behavior of carbon in iron—vanadium alloys. Powers, D.A. Rolla, MO; Univ. of Missouri (1977). 56p. University Microfilms Order No. 77-23,690.

Thesis (Ph. D.).

The temperature dependence of C diffusion in two bcc Fe-V alloys was determined. One alloy, Fe-1.06% V, which possesses an α-γ phase transformation did exhibit a high temperature diffusion anomaly. At lower temperatures where Arrhenius behavior was obeyed, its diffusion coefficient could be expressed as $D = (4.56 +- 7.76) \times 10^{-3} \exp[(-21700 +- 800)/RT]$ cm²/sec. However, the other alloy, Fe-1.52% V, which does not undergo the transformation exhibited an Arrhenius diffusion behavior throughout. Its diffusion coefficient could be expressed as $D = (4.03 +- 2.70) \times 10^{-2} \exp[(-22600 +- 700)/RT]$ cm²/sec. It is believed that this investigation demonstrated that anomalous interstitial diffusion behavior of C in dilute Fe-V alloys may be the consequence of an elastic softening as the transformation temperature is approached.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 54294, 54307, 54605, 54979, 55007, 55012, 55202, 55384

55498 (AD-A—048977) **Erosive effects of various pure and combustion-generated gases on metals. Part II. Final report, 1 June 1975-31 January 1976.** Alkidas, A.C.; Morris, S.O.; Christoe, C.W.; Caveny, L.H.; Summerfield, M. (Princeton Univ., NJ (USA). Dept. of Aerospace and Mechanical Sciences). Oct 1977. Contract DAAG46-75-C-0088. 122p. (AMS—1303). NTIS PC A06/MF A01.

This study continues the experimental investigation of the thermal and chemical erosion characteristics of steel alloys which were begun under Contract DAAG46-72-C-0078. The high pressure (approx. 3 kbars) and high temperature (approx. 3000 K) environment to which the steel specimens are subjected is produced by a ballistic compressor and by a solid propellant combustor. Equilibrium thermochemical calculations of the possible reactions indicate that the most probable reaction products are oxides, nitrides, carbides, and carbonyls, in that order. The cause of surface cracks was found to be thermal and not relatable to the degree and severity of erosion. Erosion tests of the pure metals used as alloying elements revealed that molybdenum has the highest erosion resistance, followed by nickel. There is no evidence that alloying elements alter the chemical interaction between oxygen and iron. SEM studies revealed that, when an accumulation of oxide scale occurs with successive firings, oxidation and thermal protection is provided. It is hypothesized that, as long as steel remains below its solidus temperature, the primary erosion mechanism is the reaction of combustion gases with the steel surface to form scales and the subsequent carrying-away of the scales by the high-speed flow.

55499 (COO—2995-2) **Imaging of surfaces and defects of crystals. Progress report, February 16, 1977—May 1, 1978.** Cowley, J.M. (Arizona State Univ., Tempe (USA). Dept. of Physics). Apr 1978. Contract EY-76-S-02-2995. 15p. Dep. NTIS, PC A02/MF A01.

Progress is reported in the evaluation and comparison of various electron optical techniques for the study of surface reactions on single-crystal materials. The principal reaction studied has been the oxidation of copper at temperatures of 400 to 800°C in oxygen partial pressures of 10^{-5} torr and less using thin single crystal films of copper on solid substrates. This reaction has been followed from the initial formation of oxide nuclei (100A diameter) to the growth of oxide crystals several micrometers in diameter. New information has been provided on the mechanism of the growth of the oxide and on the diffusional processes in the surrounding copper. The techniques used have included scanning electron microscopy (including electron channelling observations), scanning reflection microscopy using diffracted beams at medium energies (a technique unique to our laboratory), medium energy (1 to 15 keV) electron diffraction, transmission electron microscopy, transmission electron diffraction, high energy reflection electron diffraction and high energy reflection electron microscopy. New methods have been developed for the preparation of thin single crystal films and bulk crystals suitable for use as specimens. Exploratory studies have been made on graphite single crystals and thin chromium films. Theoretical studies have revealed possible errors in the interpretation of diffraction patterns from small crystals on mono-crystalline supports and have shown the importance of multi-beam dynamical diffraction effects in reflection-diffraction imaging of mosaic single crystals.

55500 (NTIS/PS—78/0096) **Hydrogen embrittlement of metals. Volume 2. 1975—1977 (Citations from the NTIS data base). Report for 1975—1977.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Feb 1978. 171p. NTIS PC N01/MF N01.

Studies on hydrogen embrittlement relating to mechanical properties, irradiation, crystal structure, and corrosion are cited. This compilation also covers testing, hydrogen analysis and diffusion, welding, electroplating, fabrication, and processing with respect to the ductile—brittle transition in metals. Reports on nuclear reactor materials, hydrogen storage equipment, and energy related systems are included. (This updated bibliography contains 166 abstracts, 65 of which are new entries to the previous edition.)

55501 (NTIS/PS—78/0097) **Hydrogen embrittlement of metals. Volume 2. 1976—1977 (Citations from the Engineering Index data base). Report for 1976—1977.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Feb 1978. 213p. NTIS PC N01/MF N01.

Research from worldwide journal literature on hydrogen embrittlement of ferrous and nonferrous metals is cited in this report. Studies on mechanical properties, heat treatment, crystal structure, fracture, hydrogen diffusion, grain growth, strain, pressure, and testing in relation to embrittlement are covered. This phenomenon is described in pressure vessels, pipes, welds, engineering equipment, and electroplates. (This updated bibliography contains 206 abstracts, 126 of which are new entries to the previous edition.)

55502 (NTIS/PS—78/0232) **Corrosion of stainless steel. Volume 1. 1964—1976 (a bibliography with abstracts). Report for 1964—76.** Smith, M.f. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 258p. NTIS PC N01/MF N01.

Research is cited on stainless steel composition, mechanical properties, structure, and testing in relation to corrosion. The majority of research concerns nuclear reactor materials. However, corrosion studies in coal gasification plants, rocket propellant tanks, underwater cables, batteries, and geothermal systems are also included. (This updated bibliography contains 253 abstracts, none of which are new entries to the previous edition.)

55503 (NTIS/PS—78/0233) **Corrosion of stainless steel. Volume 2. 1977—March 1978 (a bibliography with abstracts). Report for 1977-mar 78.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 79p. NTIS PC N01/MF N01.

Federally-funded research on stainless steel composition, mechanical properties, structure, and testing in relation to corrosion is cited. The majority of research concerns nuclear reactor materials. In addition, corrosion studies in coal gasification plants, rocket propellant tanks, underwater cables, batteries, and geothermal systems are included. (This updated bibliography contains 74 abstracts, 60 of which are new entries to the previous edition.)

55504 (ORNL/TM—6311) **Sensitization, intergranular attack, stress corrosion cracking, and irradiation effects on the corrosion of iron—chromium—nickel alloys.** Wu, P.C.S. (Westinghouse Electric Corp., Madison, PA (USA). Advanced Reactors Div.). Apr 1978. Contract W-7405-ENG-26. 105p. AT.

A literature review is presented on the sensitization, intergranular attack, and stress corrosion cracking of austenitic stainless steels with emphasis on dilute solutions at temperatures below the boiling point of water. An attempt is made to list the possible sources of contaminants during manufacture, shipping, construction and all phases of operation of the sodium containing components. The susceptibility of the different materials to stress corrosion cracking in the various contaminants is discussed and suggestions to prevent serious problems are made. (GHT)

55505 (ORO—5246-2) **Investigations of intermetallic alloy hydriding mechanisms. Annual progress report, July 1, 1977—April 30, 1978.** Livesay, B.R.; Larsen, J.W. (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). 30 Apr 1978. Contract EY-76-S-05-5246. 80p. Dep. NTIS, PC A05/MF A01.

Measurements of hydridation of thin films are described. Film deposition by rf sputtering is discussed and studies of microstructure changes due to hydridation are presented. The influence of factors such as alloy composition, microstructural details, surface layers or

contaminants and physical properties on hydriding characteristics such as the kinetics of hydrogen absorption and desorption, quantities absorbed, heats of hydriding and the effects of long-term absorption-desorption cycling were studied. (GHT)

55506 (UCRL—81028) **Materials compatibility study of 316 stainless steel at the LLL tritium facility.** Monahan, B.G.; Gede, V.P.; Landon, P.R.; Colmenares, C.A.; Biel, T.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Apr 1978. Contract W-7405-ENG-48. 9p. (CONF-780508—53). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

Stress corrosion tests were conducted on 316 VIM/VAR stainless steel as part of the Tritium Facility's Quality Assurance Program. Initial results under severe conditions indicate earlier-than-expected failure. We are expanding our tests to further examine this problem.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 55015, 56305, 56311

55507 (AD-A—049119) **Irradiation effects on fatigue crack propagation in austenitic stainless steels. Memorandum rept.** Michel, D.J. (Naval Research Lab., Washington, DC (USA)). Sep 1977. Contract E(49-5)-2110. 25p. (NRL-MR—3610). NTIS PC A02/MF A01.

The effects of fast-neutron irradiation on subcritical crack propagation in austenitic stainless steels are reviewed with respect to the influence of irradiation and test temperatures, neutron fluence, hold-time effects, and thermomechanical history. Predictive methods for estimating crack propagation performance are discussed.

55508 (HEDL-SA—1428) **Influence of preirradiation thermal-mechanical treatment on phase stability and swelling in 316 stainless steel.** Brager, H.R.; Garner, F.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1978. Contract EY-76-C-14-2170. 6p. (CONF-780622—61). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

The radiation-induced void swelling phenomenon in metals was investigated in a series of experiments to determine its sensitivity to preirradiation thermal-mechanical treatment. Stainless steel-316 was tested with residual cold work levels of 0, 10, 20, and 30%. Results are presented. (GHT)

55509 (HEDL-SA—1476) **Second phase precipitation in irradiated Type 316 stainless steel cladding.** Hales, J.W. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1978. Contract EY-76-C-14-2170. 17p. (CONF-780622—52). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

Differences in the phase composition of FFTF fuel cans following irradiation in the General Electric Test Reactor compared to HEDL fuel cans prompted laboratory studies to be conducted using cladding from the same lots of material used to fabricate the fuel pins and on cladding sections removed from the plenum area of the irradiated fuel pins to help establish the cause of the observed differences. (GHT)

55510 (HEDL-TME—78-9) **Densification-induced strains in 20% cold-worked 316 stainless steel during neutron irradiation.** Garner, F.A.; Cummings, W.V.; Bates, J.F.; Gilbert, E.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1978. Contract EY-76-C-14-2170. 22p. Dep. NTIS, PC A02/MF A01.

A correlation has been developed to describe the densification and resultant strains of 20 percent cold-worked 316 stainless steel fuel pin cladding during neutron irradiation at elevated temperatures. The correlation describes the mean density change as a function of time, temperature and carbon content. The densification arises from the recovery of deformation-induced strains and the precipitation of various secondary phases. The major portion of the densification occurs prior to the formation of radiation-induced voids and is independent of the swelling phenomenon. The densification process is similar in both N-lot and first core heats of steel. The resultant strains indicate that the process is anisotropic with the length change larger and the diameter change smaller than expected for isotropic deformation.

55511 **Neutron irradiation and annealing studies of V_3Ga.** Francavilla, T.L.; Das, B.N.; Gubser, D.U.; Meussner, R.A. (Naval Research Lab., Washington, D.C. (USA)); Sekula, S.T. (Oak Ridge National Lab., Tenn. (USA)). *J. Nucl. Mater.;* **72**: No. 1, 203-211(Mar 1978).

From Conference on radiation effects on superconductivity; Argonne, USA (13 - 16 Jun 1977).

Studies of the effect of fast neutron irradiation (E>1 MeV, at 60°C) on the superconducting properties of V_3Ga of compositions spanning the A15 phase field have shown that V_3Ga exhibits an increasing susceptibility to damage with increasing Ga concentration. Annealing studies have shown that recovery from neutron damage occurs in two temperature ranges. Activation energies are estimated for these processes which are correlated with an unusual recovery of the lattice parameter. A simplified vacancy interstitial mechanism is proposed which could account for these results.

55512 (SAND—78-1089C) **Implantation metallurgy.** Vook, F.L. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 23p. (CONF-780655—1). Dep. NTIS, PC A02/MF A01.

From NRC solid state sciences committee and panel meeting; Oak Ridge, TN, USA (1 Jun 1978).

Ion implantation, when combined with ion backscattering and transmission electron microscopy, is beginning to forge a powerful new discipline for the modification and study of metals. This discipline has been given the name implantation metallurgy and it complements the more developed ion implantation doping of semiconductors. A very promising new area of implantation metallurgy is the rapid production of specially tailored equilibrium phases for metallurgical research and development. The intimate atomic mixtures with controlled compositions that are prepared by ion implantation permit the rapid low-temperature formation of desired phases which can be characterized by electron microscopy and diffraction. Interfacial effects are avoided and the use of ion backscattering to continually and nondestructively monitor the depth distribution of the implanted atom concentration to depths beyond the implanted layer permits sensitive determinations of solubilities, diffusion rates and phase diagrams of equilibrium phases of intermetallic alloys.

55513 **Study of defects in metals with positive muons.** Gauster, W.B. (Sandia Labs., Albuquerque, N.Mex. (USA)); Fiory, A.T. (Bell Labs., Murray Hill, N.J. (USA)); Lynn, K.G. (Brookhaven National Lab., Upton, N.Y. (USA)); Kossler, W.J. (College of William and Mary, Williamsburg, Va. (USA)); Parkin, D.M. (Los Alamos Scientific Lab., N.Mex. (USA)); Stronach, C.E. (Virginia State Coll., Petersburg (USA)); Lankford, W.F. (George Mason Univ., Fairfax, Virginia (USA)). *J. Nucl. Mater.;* **69**: No. 70, 147-156(Feb 1978).

From International conference on the properties of atomic defects in metals; Argonne, USA (18 - 22 Oct 1976).

The technique of positive muon spin depolarization is reviewed, and its sensitivity to the presence of defects in metals is discussed. Results are presented of an experimental survey on copper, aluminum, indium and beryllium. There are indications of μ^+ trapping at defects in neutron-irradiated and deformed copper, in indium near its melting point, and in beryllium. The results are discussed in the context of muon diffusion.

55514 **Irradiation temperature determination by electrical resistivity measurements.** Lee, F.; Matolich, J. Jr.; Moteff, J. (Univ. of Cincinnati). *Nucl. Technol.;* **39**: No. 2, 207-212(Jul 1978).

Postirradiation electrical resistivity changes have been found to be a measure of the irradiation temperature. Molybdenum and tungsten rod specimens were irradiated in the Experimental Breeder Reactor II to a neutron fluence of 1.1E + 26 n/m² (E/sub n/ > 1 MeV) simultaneously at six different temperatures, ranging from 455 to 1050°C. The post-irradiation isochronal resistivity measurements made on the specimens showed a close relationship between the initial resistivity recovery temperatures and the original temperatures determined from the melt wires and SiC monitors irradiated in the same capsules. Experimental results indicated the possibility of molybdenum and tungsten wires as irradiation temperature monitors (molybdenum up to 850°C and tungsten up to approximately 1400°C).

55515 **Effects of irradiation at cyrogenic temperatures and electron irradiation on Tsub(c) and the transport properties of A-15 superconductors.** Ghosh, A.K.; Weismann, H.; Gurvitch, M.; Lutz, H.; Kammerer, O.F.; Snead, C.L.; Goland, A.; Strongin, M. (Brookhaven National Lab., Upton, N.Y. (USA)). *J. Nucl. Mater.;* **72**: No. 1, 70-75(Mar 1978).

From Conference on radiation effects on superconductivity; Argonne, USA (13 - 16 Jun 1977).

The electrical resistivity rho and Tsub(c) have been measured on vapor deposited films of Nb_3Ge and Nb_3Sn subjected to α-particle and electron irradiation. Both Nb_3Sn and Nb_3Ge films held at 30 K were irradiated with 2.5 MeV α-particles. Tsub(c) and rho_0, the electrical resistivity at 25 K, were measured in situ as a function of fluence without warming up the samples. In addition, Nb_3Sn films held at 50°C were irradiated with 2.0 MeV electrons. Tsub(c) was found to correlate with rho_0, which implies that Tsub(c) is affected by the total defect concentration. Of particular interest is the shape of the Tsub(c) vs. rho_0 curve for low fluences. A discussion is given of why this low fluence region is important in distinguishing between different models of Tsub(c) depressions. It is believed that the strong depression in Tsub(c) with increasing rho_0 (until saturation of

Tsub(c)) is due to smearing of the density of states. The density of states in the damaged films was estimated from critical field data, along with measurement of rho$_0$.

55516 Effect of radiative stimulation of helium-pore formation in molybdenum. Ibragimov, A.S.S.; Reutov, V.F.; Zhdan, G.T. (Nuclear Physics Institute, Academy of Sciences of Kazakh SSR, Alma-Ata). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 1, 71-72(Jan 1978).

Annealed samples of Mo were irradiated with 29-Mev α-particles at 300, 700, and 1100 °C. The microstructure was examined by electron microscopy.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 55625

55517 (NTIS/PS—78/0248) **Magnesium oxide ceramics and refractories (citations from the NTIS data base). Report for 1964—Mar 78.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 213p.

Federally funded research is cited on the structure, deformation, mechanical properties, fabrication, radiation effects, tests, and thermodynamic properties. Studies on phase diagrams, diffusion, and electrical, high temperature, and nuclear reactor applications are also presented. (This updated bibliography contains 208 abstracts, 23 of which are new entries to the previous edition.)

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 54677, 54680, 55457, 55519

STRUCTURE AND PHASE STUDIES

55518 (ORO—5111-2) **Microstructural studies of hydrogen and deuterium in bcc refractory metals. Progress report, 1 June 1977—31 May 1978.** Moss, S.C. (Houston Univ., TX (USA). Dept. of Physics). 1978. Contract EY-76-S-05-5111. 6p. Dep. NTIS, PC A02/MF A01.

Research into the microstructural incorporation of H and D in the Group VB metals is reported. Both atomic displacements and elastic interactions in dilute solutions and the ordering transition in a more concentrated alloy (V_2D) were studied. The influence of D in replicating or imitating a structural phase transition, i.e. the omega phase, was studied in a preliminary way with elastic neutron scattering. (GHT)

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 54991

55519 (AD-A—050595) **Frs composites for advanced gas turbine engine components. Final report.** Brentnall, W.D. (TRW, Inc., Cleveland, OH (USA)). Aug 1977. Contract N62269-76-C-0355. 41p. (TRW-ER—7887-F). NTIS PC A03/MF A01.

Continued property characterization and fabrication process development of fiber reinforced superalloy (FRS) composites is described. The current investigations included determination of impact toughness, low cycle fatigue properties and thermal fatigue behavior of angle plied specimens in the W-1ThO_2/FeCrAlY system. Additionally, process feasibility studies were performed in the areas of monotape fabrication, secondary bonding and hollow simulated airfoil fabrication. The feasibility of using the pre-consolidated monotape FRS blade fabrication process was demonstrated.

55520 (NTIS/PS—78/0263) **Fracture of ceramics. Volume 1. 1964—1976 (a bibliography with abstracts.). Report for 1964—76.** Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 255p. NTIS PC N01/MF N01.

Citations of research on ceramic fracture in relation to fabrication, microstructure, mechanical properties, tests, and composition are covered in this bibliography. Reports include ceramic use in rocket components, gas turbines, nuclear reactors, and structural parts. (This updated bibliography contains 250 abstracts, none of which are new entries to the previous edition.)

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 55457, 55490

55521 (DP-MS—78-8) **Control of microstructural damage produced by helium in $^{238}PuO_2$ pellets.** McDonell, W.R.; Gould, T.H. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1978. Contract EY-76-C-09-0001. 20p. (CONF-780622—59). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

Interim heating above 1200°C at intervals less than 6 months released helium without grain-boundary separations in small-grained, 80%-dense $^{238}PuO_2$ pellets stored for long times at low temperatures. However, preheating at temperatures below the 1200°C threshold for grain separation did not release sufficient helium to prevent grain separations at higher temperatures. Size limits on the high-density regions of the microstructure will be necessary to avoid grain separations produced by helium release in $^{238}PuO_2$ after prolonged storage, if the interim release treatments cannot be conveniently employed.

55522 Crystal-field properties of $Yb_2Ti_2O_7$ using ^{170}Yb Moessbauer spectroscopy. Dunlap, B.D.; Shenoy, G.K.; Friedt, J.M.; Meyer, M.; McCarthy, G.J. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev., B;* **18**: No. 4, 1936-1941(15 Aug 1978).

Moessbauer spectroscopy has been used to investigate the crystal-field levels of Yb^{3+} in $Yb_2Ti_2O_7$. The hyperfine field observed when an external field is applied provides a local magnetization measurement which has been interpreted in terms of an appropriate crystal-field Hamiltonian. A procedure is described for performing a powder average to include the effects of magnetic anisotropy in the calculations. Combining the current results and previous measurements on isomorphic compounds gives crystal-field values of $B^0_2 = 15—21$ K and $B^0_4/B^0_2 = 0.01$.

55523 Theory of Mott insulators. Brandow, B.H. (Los Alamos Scientific Lab., NM). *Int. J. Quant. Chem., Symp.;* No. 10, 417-434(1976).

The main characteristics of Mott insulator materials are qualitatively explained by means of a suitable form of Hartree-Fock approximation. This can be regarded as an extension of the Slater antiferromagnetic band theory. Semiquantitative applications to NiO and CoO are described. The aspects discussed include the insulating gap, origin of the antiferromagnetic spin coupling, reasons for the validity of the crystal-field model, 3d bandwidth questions, and a survey of the basic microscopic mechanisms responsible for related insulator-metal transitions.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 54266

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 54992

55524 (AD-A—050663) **Thermal and ultrasonic transport properties of dielectric and piezoelectric solids. Final report 15 Nov 73—14 Nov 76.** Klemens, P.G.; Lipschultz, F.P. (Connecticut Univ., Storrs (USA)). 14 Dec 1976. 20p. NTIS PC A02/MF A01.

This final report describes measurements of the thermal conductivity of single crystal alumina from 1 to 70 K and the effect of electron irradiation, and of the thermal conductivity and ultrasonic attenuation of lithium niobate. Point defect scattering of phonons was also studied through lattice thermal conductivity of copper-germanium. Theory of thermal conductivity of crystals at high temperatures was extended in terms of four-phonon processes, optical modes and thermal expansion. A surface wave transducer can be made by periodically modulating a piezoelectric surface; attempts to make such a device are described. (Author)

55525 Metastable metallic phase in vanadium dioxide films. Bugaev, A.A.; Gavrilyuk, A.I.; Gur'yanov, A.A.; Zakharchenya, B.P.; Chudnovskii, F.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 1, 27-28(Jan 1978).

Vanadium dioxide films were stabilized in the metallic phase at a low temperature as the result of irradiation with electron and laser pulses.

55526 Effect of ion bombardment on the metal—dielectric phase transition in VO_2. Lanskaya, T.G.; Suvorov, A.V.; Terukov, E.I. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 1, 45-46(Jan 1978).

VO_2 films were bombarded with 40-keV argon ions and the dose necessary for conversion to the amorphous state was determined.

COMPOSITE MATERIALS

55527 (NTIS/PS—78/0091) **Reinforced plastics. Part 2. Boron, carbon, and other reinforcing materials. volume 2. 1976—January 1978 (a bibliography with abstracts). Report for 1976—January 78.**

Smith, M.F. (National Technical Information Service, Springfield, VA (USA)). Feb 1978. 198p. NTIS PC N01/MF N01.

Studies on reinforced epoxy, polyimide, polyester, and phenolic matrices are covered. Polymers for reinforced plastics are also described. Citations on fabrication, lamination, mechanical properties, stress analysis, and viscoelasticity are included. Reinforced plastics for aircraft and spacecraft applications are also cited. (This updated bibliography contains 193 abstracts, 107 of which are new entries to the previous edition.)

PREPARATION AND FABRICATION

55528 (BNL—50790) **Development of a glass polymer composite sewer pipe from waste glass. Progress report No. 6, October—December 1977.** Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). 1977. Contract EY-76-C-02-0016. 15p. Dep. NTIS, PC A02/MF A01.

Large quantities of energy can be conserved by recycling municipal solid waste. Reductions in the costs associated with waste disposal such as by landfilling can also be accrued. While uses for recycled ferrous and non-ferrous metals are apparent, uses for the glass fraction which constitutes approximately 10% of municipal solid waste, have not been developed. As a result, a program to develop methods for incorporating waste glass into composites which can be used for construction materials was started in July 1976. Since that time the properties of as-produced glass polymer composite (GPC) sewer pipe have been measured, durability tests started, field testing of full-scale specimens initiated, and calculations made to determine the energy requirements and costs. Work accomplished during the period October 1—December 31, 1977 is described in the current report.

55529 (BNL—50835) **Development of a glass polymer composite sewer pipe from waste glass. Progress report No. 7, January—March 1978.** Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 18p. Dep. NTIS, PC A02/MF A01.

Large quantities of energy can be conserved by recycling municipal solid wastes. Reductions in the costs associated with waste disposal such as by landfilling can also be accrued. While uses for recycled ferrous and non-ferrous metals are apparent, uses for the glass fraction which constitutes approximately 10% of municipal solid waste have not been developed. As a result, a program to develop methods for incorporating waste glass into composites which can be used for construction materials was started in July 1976. Since that time the properties of as-produced glass polymer composite (GPC) sewer pipe have been measured, durability tests started and field testing of full-scale specimens initiated. Based upon the as-produced properties, calculations have been made to determine the energy requirements and costs. Work accomplished during the period January 1—March 31, 1978 is described in the current report.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 54854

CORROSION, EROSION, AND DEGRADATION

55530 (AD-A—049058) **Sharp notch stress corrosion cracking of B/Al and G/Al composites. Interim report.** Phillips, W.L. (Naval Research Lab., Washington, DC (USA)). Oct 1977. 22p. (NRL-MR—3616). NTIS PC A02/MF A01.

Sharp notch stress corrosion properties of transverse-loaded, uniaxially aligned B/6061-T6 Al, B/6061-F Al, B/2024-F Al and G/201 Al/2024 Al composites have been evaluated in a salt water environment and in laboratory air. For both environments, delayed time fractures were observed in those B/Al specimens that were dead weight-loaded to stress intensities greater than approximately 80% of the overload fracture toughness. Fractures did not occur, within the 1000 hour time limit, for specimens subjected to lower stress intensities. Based on comparisons of the data for salt water and air exposures, analyses of the crack- opening-displacement versus time data, and appearances of the fracture surfaces, it is concluded that the delayed time failures in B/Al were caused by room temperature creep. For the G/Al composite, load-carrying capacity was reduced about 25% due to 1000 hour immersion in salt water. Delayed time failures were attributed to the combined effects of room temperature creep and pitting corrosion adjacent to the crack tip.

POLYMERS AND PLASTICS

REFER ALSO TO CITATION(S) 55377

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 55574

PHYSICAL PROPERTIES

55531 (EPRI-EL—647) **Electrochemical treeing in cable. Final report.** Nagu Srinivas, N.; Deopken, H.C.; McKean, A.L.; Biskeborn, M.C. (Phelps Dodge Cable and Wire Co., Yonkers, NY (USA)). Jan 1978. 218p. Dep. NTIS, PC A10/MF A01.

Results are presented of an investigation of electrochemical treeing in solid dielectric insulated cables performed between May, 1973 and March, 1977 for the Electric Power Research Institute. The purpose of the work was to establish the influence of various electrical, thermal and chemical parameters on the rate of growth of electrochemical trees in polyethylene (PE), crosslinked polyethylene (XLPE) and ethylene-propylene rubber (EPR). The main conclusions from this work are: (1) The rate of electrochemical tree growth is most strongly influenced by voltage stress and frequency. (2) Both XLPE and EPR exhibit substantially lower growth rates than PE. (3) The lower tree growth rate in XLPE is attributable primarily to the presence of catalyst by-products of the crosslinking reaction—principally acetophenone. (4) Electrochemical trees decrease the dielectric strength of PE, XLPE and EPR.

55532 **Standard test method for volume change of elastomeric materials in hydraulic fluids under static conditions.** *Annu. Book ASTM Stand.;* No. 25, 355-360(1977).

ANSI/ASTM-D—3604-77.

The volume change of elastomeric materials immersed in hydraulic fluids under static conditions was determined by placing a sample of known dimensions and weight in a container of the fluid for 168 h at 70 +- 1°C. At the end of the test period, the samples were cleaned, dried, and weighed in air and in distilled water.

OTHER MATERIALS

55533 (CONF-770701—(Absts.)) **Proceedings of the 13th biennial conference on carbon. Extended abstracts and program.** (American Carbon Society, University Park, PA; Aerospace Corp., El Segundo, CA (USA); TRW, Inc., Redondo Beach, CA (USA)). 1977. 505p. American Carbon Society, c/o Pennsylvania State Univ., University Park, PA $15.00.

From 13. biennial conference of the American Carbon Society; Irvine, CA, USA (18 Jul 1977).

Properties of carbon are covered including: mechanical and frictional properties; chemical reactivity and surfaces; aerospace applications; carbonization and graphitization; industrial applications; electrical and thermal properties; biomaterials applications; fibers and composites; nuclear applications; activated carbon and adsorption; advances in carbon characterization; and micromechanics and modeling. (GHT)

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 54830, 54831, 54832, 55201

55534 (AD-A—048848) **Chemically vapor deposited semi-conductors for laser and infrared window applications. Final technical report, 15 May 1975—15 November 1976.** Swanson, A.; Miles, P.; Pappis, J. (Raytheon Co., Waltham, MA (USA). Research Div.). Jul 1977. Contract F33615-75-C-5223. 70p. (S—2146). NTIS PC A04/MF A01.

The second part of this program has demonstrated the feasibility of depositing a microcrystalline form of gallium phosphide by a chemical vapor deposition process. Although close to theoretical transmittance was achieved between 5 and 12 micrometers, the material still contains residual pores that cause unacceptable scatter at visible wavelengths. Techniques were also developed to bond thin layers of this material to zinc selenide to form a composite window that withstands the mechanical abrasion of rain and particulate impacts better than other materials that are currently available. Further work is needed before an optimum bonding glass or mechanical attachment technique is developed. The first part of the program summarizes additional work performed on the chemical vapor deposition of cadmium telluride. In spite of the wider range of process conditions investigated with the elemental process, residual porosity reduces the transmittance to an unacceptable level. A chemical vapor deposition process that uses hydrogen telluride gas is apparently required to deposit laser quality material. The use of this gas will require, however, that improved forming and handling techniques be developed.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 54991, 56029

55535 Polarized electronic spectra for the crystals of three compounds, potassium tetrabromoplatinate(II) dihydrate, tetraethylammonium hexabromodiplatinate(II), and tetra-μ-glycinedimolybdenum(II) sulfate tetrahydrate. Peters, T.J. Ames, IA; Iowa State Univ. (1977). 132p. University Microfilms Order No. 77-26,004.

Thesis (Ph. D.).

Crystals of $K_2PtBr_4 \cdot 2H_2O$ have an orthorhombic unit cell with a = 8.31(2) A, b = 13.73(3) A and c = 4.84(1) A. The polarized absorption spectra for $K_2PtBr_4 \cdot 2H_2O$, $[N(C_2H_5)_4]_2Pt_2Br_6$, and $Mo_2(O_2CCH_2NH_3)_4(SO_4)_2 \cdot 4H_2O$ were recorded at 300 and 15°K. In $K_2PtBr_4 \cdot 2H_2O$ the bands at 24,000 and 27,000 cm^{-1} in both a and b polarizations appear to be vibronically induced. The energy spacing of the vibrational structure was noted to be somewhat higher at 180 cm^{-1} than that for the analogous structure of K_2PtBr_4. The presence of a $PtBr_6^{2-}$ impurity gave rise to red sections, which evidently were due to the electron transfer, Pt(IV) reverse → Pt(II). Very weak spin-forbidden bands were observable in all three polarizations below 23,500 cm^{-1}. In the crystal spectra of $[N(C_2H_5)_4]_2Pt_2Br_6$ the transitions were defined with respect to the three molecular axes of the $Pt_2Br_6^{2-}$ ion. Excited states were assigned under the D/sub 2h/ point group symmetry of the ion. The delocalization of the d electrons gave rise to strongly enhanced intensities for both spin-forbidden and spin-allowed d reverse → d transitions. The M reverse → L charge-transfer transitions occur at lower energies in the case of $Pt_2Br_6^{2-}$ than in $PtBr_4^{2-}$. These charge transfer transitions were found to originate from the terminal bromides. The crystal spectra of $Mo_2(O_2CCH_2NH_3)_4(SO_4)_2 \cdot 4H_2O$ were recorded through the region 20,000 to 25,000 cm^{-1}. The spectra at 15°K revealed the vibrational structure in the two recorded polarizations. The electronic transition observed in these spectra was forbidden under the local symmetry of D/sub 4h/. The crystallographic site symmetry was S_4. The observed transition was attributed to a vibronic excitation.

55536 Single crystal electronic spectra for the compounds potassium octachlorodimolybdate(II)-dihydrate, potassium tetra-μ-sulfatodimolybdate(II)-dihydrate and potassium tetra-μ-sulfatodimolybdate(II,III)-3.5 hydrate. Fanwick, P.E. Ames, IA; Iowa State Univ. (1977). 131p. University Microfilms Order No. 77-25,984.

Thesis (Ph. D.).

Polarized electronic absorption spectra were obtained at room and liquid-helium temperatures. Because of a disorder in structure of $K_4Mo_2Cl_8 \cdot 2H_2O$, the dipole-allowed transition ^{1}A/sub 2u/ reverse → ^{1}A/sub 1g/ (delta* reverse → delta) at 19,300 cm^{-1} could be measured at 3.7°K for 7% of the molecules. An irregularly spaced vibrational progression was observed in this band. Pellet spectra of $K_4Mo_2Cl_8 \cdot 2H_2O$ displayed a similar irregularity, while pellets of the anhydrous compound did not. Bands were also observed at 22,000 cm^{-1} and 28,800 cm^{-1}, but no definitive assignments could be made for them. $K_4Mo_2(SO_4)_4 \cdot 2H_2O$ displayed a spectrum quite similar to the $Mo_2Cl_8^{4-}$ salt with respect to the energy of the transitions. However, the delta* reverse → delta transition at 19,400 cm^{-1} displayed no vibrational structure and was much less intense than in $K_4Mo_2Cl_8$. Also, a vibronic component in the opposite polarization was observed. The loss in intensity was explained by a backbonding model in which the delta*-orbital interacted strongly with a sulfate e anti-bonding orbital. The transition ^{2}B/sub 1u/ reverse → ^{2}B/sub 2g/ (delta* reverse → delta) was observed in the near-ir for $K_3Mo_2(SO_4)_4 \cdot 3.5H_2O$. At 5 K it displayed six vibrational progressions. Three were clearly z-polarized and assigned as Mo—Mo and Mo—O stretching modes on the O—O transition. The other series were assigned as vibronic progressions based on exciting e/sub g/ modes. Lastly, a proposed assignment, ^{1}A/sub 2u/ reverse → ^{1}A/sub 1g/ (delta* reverse → delta), for the spectra of the alkylcarboxylate dimers was offered. Polarized crystal spectra for the compounds $Mo_2(CF_3CO_2)_4$ and $Mo_2(CF_3CO_2)_4 \cdot 2(C_6H_5N)$ were obtained to illustrate the model. In the spectrum of $Mo_2(CF_3CO_2)_4$ highly distorted Frank—Condon ratios were observed; it was proposed that these were due to an a/sub 1g/ Hertzberg—Teller interaction.

55537 Temperature dependence of the spin-lattice relaxation rates in the triplet state of pyrazine at low temperatures. Hall, L.H.; El-Sayed, M.A. (Univ. of California, Los Angeles). *Chem. Phys. (Amsterdam);* **8**: 272-288([nd]).

The electron spin—lattice relaxation (SLR) rate constants have been measured for the triplet state of pyrazine-d_4 in a cyclohexane matrix from 2 to 8 K by resolving the phosphorescent decay curve into three exponential components. A matrix kinetics is presented that gives the relationship between the SLR rate constants and the observed decay component rate constants and the decay component intensities of the three zero-field levels. An exact numerical procedure based on the Newton—Raphson technique is described in detail for systems of two and three coupled levels. This procedure was used to find the SLR rate constants starting from either the decay component rate constants or the decay component intensities. Both the matrix kinetics and the numerical procedure should be useful in many other studies involving multilevel systems whose sublevels are connected by some combination of SLR and microwaves. The observed SLR rate constants are best explained as a function of temperature as the sum of a direct process (linear in T) and a Raman process (T^7 dependence). Their relative magnitudes indicate that the Raman process is probably anharmonic. Various mechanisms for SLR in this system are examined, and a short review of SLR theory and experiment is given. The nature of the zero-field sublevels in pyrazine-d_4 is also discussed as is the effect of the choice of matrix solvent upon SLR rate constants and the phosphorescent spectrum.

PROPERTIES

55538 (AD-A—050296) **Properties of new superconducting materials. Final research report.** Geballe, T.H. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Dec 1977. 21p. (GL—2760). NTIS PC A02/MF A01.

A large number of new and unusual superconductors have been discovered and their superconducting response to changes effected chemically, crystallographically, and physically has been studied. In this way, the interactions giving rise to superconductivity were examined. The effort has been concentrated in two major areas. First, the two-dimensionality of layered transition metal dichalcogenides, has allowed a closer comparison between theory and experiment. Second, studying the instabilities of the high transition temperature phases has led to a greater understanding of the role of crystal structure and stoichiometry. For example, a new method of stabilizing films of Nb_3Ge with superconducting transitions above 22K enabled the homogeneous stoichiometric composition to be reached by epitaxial growth on polycrystalline substrates. Thus, new approaches have been uncovered for synthesizing compounds with even higher superconducting transition temperatures.

55539 (UCRL—52434(Vol.3)) **Development of alternate silicone potting compounds. Vol. 3. Development of substitute No. 1 for Dow Corning's aerospace sealant, DC 93-120.** Cady, W.E.; Buckner, A.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Apr 1978. Contract W-7405-ENG-48. 32p. Dep. NTIS, PC A03/MF A01.

A substitute for DC 93-120 aerospace sealant can be formulated by blending Sylgard 184 with Sylgard 186 and accelerating the blend with accelerator XCF3-6559 to achieve our goals of an initial viscosity of 10 Pa.S at 25°C and a gel time of 90 min at 25°C. One lot of Sylgard 184 was evaluated with two lots of Sylgard 186 of slightly differing catalyzed viscosities and gel times. Three combinations of Sylgard 184, Sylgard 186, and accelerator were formulated and evaluated; these combinations met goals of viscosity, gel time, and extractables of less than 6 wt%. The two Sylgard 186's required slightly different amounts of Sylgard 184 to achieve a viscosity of 10 Pa.s.. The gel time was achieved with 5-6 parts of accelerator per 110 parts of blend. At 6 parts of accelerator, the difference in the cure rate of the two lots of Sylgard 186 became insignificant.

55540 Interband absorption in a strongly correlated half-filled band Hubbard chain: Effect of long-range Coulomb interaction. Lyo, S.K. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Phys. Rev., B;* **18**: No. 4, 1854-1858(15 Aug 1978).

We study the effect of a weak long-range Coulomb interaction on the interband absorption in a strongly correlated half-filled-band Hubbard chain such as low-dimensional charge-transfer organic salts by introducing a small nearest-neighbor Coulomb repulsion (U_1) to the Hubbard model. A long-range interaction gives rise to an attractive potential well between the doubly occupied site and the hole and distorts the interband absorption line shape for transitions to the upper Hubbard band. Also, it leads to formation of, and additional transitions to, a bound excitonic state. With an increasing value of U_1, the intensity leaks gradually from the former transitions to the latter, while the total intensity is conserved.

55541 Possible mechanism of high-temperature superconductivity. Abrikosov, A.A. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 4, 219-222(20 Feb 1978).

A superconductivity mechanism based on the formation of "metallic excitonium", the exciton phase in a semiconductor or in a semimetal with m/sub e//m/sub a/ < or ≈0.01, is proposed.

55542 Influence of void compaction and material non-uniformity on the propagation of one-dimensional acceleration waves in granular materials. Nunziato, J.W.; Walsh, E.K. (Sandia Labs., Albuquerque, NM). *Arch. Ration. Mech. Anal.;* **64**: No. 4, 299-316(1977).

The theory of granular materials proposed by COWIN and GOODMAN is considered and the behavior of one-dimensional acceleraton waves in non-conducting materials with a non-uniform, initial volume distribution of granules is examined. In particular, an attempt is made to determine how the behavior of such waves is influenced by coupling effects arising from the two different modes of compressibility and by dispersive effects resulting from the initial non-uniformity of the volume distribution function.

CORROSION, EROSION, AND DEGRADATION

55543 (BNWL-SA—6070) **Chemical durability of zinc borosilicate nuclear waste glass.** Westsik, J.H. Jr.; Mendel, J.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1977. Contract EY-76-C-06-1830. 20p. (CONF-770416—10). Dep. NTIS, PC A02/MF A01.

From 79. annual meeting of American Ceramic Society; Chicago, IL, USA (23 Apr 1977).

Chemical durability is of primary concern when evaluating the safety of waste glass. For this reason, testing the leachability of waste glasses is a fundamental part of their development and characterization. The leachability is also very much a function of glass composition as previously discussed. This discussion is limited to a representative waste glass composition, a high-zinc borosilicate formulation which has been studied in detail by Battelle Pacific Northwest Laboratories. (GHT)

RADIATION EFFECTS

55544 (AD-A—050785) **Radiation effects on the electrical properties of MOS device materials. Final report 2 Mar 76—28 Feb 77.** Hughes, G.W. (RCA Labs., Princeton, NJ (USA)). Feb 1978. Contracts DAAG39-76-C-0088;DNA-MIPR-76-654. 63p. (PRRL—77-CR-37). NTIS PC A04/MF A01.

Radiation-hard SiO_2 on Si grown by three different processes (dry, pyrogenic steam, and hybrid) has been examined by vacuum ultraviolet techniques. Flatband shift vs time measurements provide estimates of capture cross sections and trap densities. Current-enhancement measurements provide qualitative information about trapping at both the Si-SiO_2 and gate-SiO_2 interface. Results show that unannealed dry oxides have the lowest interface-state density after irradiation, making them more desirable for applications where switching speed is important. Annealing in argon at 800 C increases both the hole-trap and interface-state density. All dry oxides have a dominant trap with capture cross section S approx. $= 5 \times 10^{-14}$ cm^2 at applied oxide fields $E_0 = 1$ MV/cm. Pyrogenic steam oxides have many more interface stfores after irradiation than dry oxides and can be characterized by a dominant trap with S approx. 5×10^{-14} to 10^{-12} cm^2 for $E_0 = 1$ MV/cm. Hybrid oxides grown in 3% HCl steam followed by dry O_2 show S approx. 2×10^{-13} cm at $E_0 = 1$ MV/cm. The larger capture cross section for these oxides is believed to be due to the presence of HCl. All oxides show a neutral trap capture cross section which is approximately inversely proportional to applied oxide field. Both pyrogenic steam and dry hard oxides can be characterized by the same trap. The difference between the two oxides appears to be only the density of interface states.

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 55591

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 55907

55545 **Using the proton backscattering method of light element profiling to achieve tailored low Z impurity distributions in solids.** Blewer, R.S. (SANDIA LABS., ALBUQUERQUE, N.MEX. (USA)). *Nucl. Instrum. Methods;* **149**: No. 1, 47-52(1978).

From 3. international conference on ion beam analysis; Washington, D.C., USA (27 Jun - 1 Jul 1977).

The proton backscattering technique has been used to evaluate efforts to achieve tailored depth profiles of implanted impurities in solids. A comprehensive example involving uniform depth profiles of helium implanted into erbium deuteride is presented. A computer program was developed to predict a combination of fluences and energies that should sum to a uniform composite depth profile. However, initial implant parameters selected were found to lead to severe near-surface non-uniformities. A parametric study of possible causative factors (fluence, heating, and flux dependences) revealed that it is necessary to limit the helium concentration to a critical value in order to achieve and retain depth uniformity. The necessary combination of fluences and impact energies is given for the example chosen.

55546 **Profiling hydrogen in materials using ion beams.** Ziegler, J.F. (IBM WATSON RESEARCH CENTER, YORKTOWN HEIGHTS, N.Y. (USA)); WILLIAMS, P.; DELINE, V.R.; EVANS, C.A. JR. (ILLINOIS UNIV., URBANA (USA). MATERIALS RESEARCH LAB.); WHITE, C.W.; CLARK, G.J.; APPLETON, B.R.; ALLRED, D.D. (OAK RIDGE NATIONAL LAB., TENN. (USA)); TERREAULT, B. (QUEBEC UNIV., VARENNES (CANADA). ENERGY RESEARCH CENTRE); SCHERZER, B.M.U. *Nucl. Instrum. Methods;* **149**: No. 1, 19-39(1978).

From 3. international conference on ion beam analysis; Washington, D.C., USA (27 Jun - 1 Jul 1977).

Over the last few years many ion beam techniques have been reported for the profiling of hydrogen in materials. The authors have evaluated nine of these using similar samples of hydrogen ion-implanted into silicon. When possible the samples were analysed using two or more techniques to confirm the ion-implanted accuracy. The results of this work, which has produced a consensus profile of H in silicon which is useful as a calibration standard, are reported. The analytical techniques used have capabilities ranging from very high depth resolution (approximately 50 A) and high sensitivity (<1 ppm) to deep probes for hydrogen which can sample throughout thin sheets (up to 0.2 mm thick).

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 54585, 54589, 54591, 54598, 54601, 54602, 54607

55547 (AD-A—050912) **Analysis of trace volatiles by gas chromatograph/mass spectrometer data system. Interim report Jan 76-Oct 77.** Martin, C.L.; Lackey, W.W.; Conkle, J.P.; Miller, R.L. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Dec 1977. 17p. (SAM-TR—77-28). NTIS PC A02/MF A01.

Methods and procedures are described for the analysis of trapped volatile samples by gas chromatography-mass spectrometry. The Tenax-GC sorbent tube sampler (stainless steel) and the desorption heater block described were developed in this laboratory to satisfy a USAF need for a field sampling method to complement the SAM cryogenic trapping system. The treatment of both sorbent-trapped and cryogenically-trapped samples is discussed showing that analysis and data reduction for sorbent tube samples are considerably less than that required for cryogenic samples. While the sorbent tube sampling method has advantages of lower cost, ease of portability, simplicity, and reduced analysis time, the cryogenic sampling system is the preferred method for trapping light hydrocarbons of less than five carbon atoms. (Author)

55548 **Standard test method for total cobalt in alumina-base cobalt—molybdenum catalyst by the potentiometric titration method.** *Annu. Book ASTM Stand.;* No. 25, 701-703(1977).

ANSI/ASTM-D—3610-77.

In order to determine cobalt in freshly-prepared cobalt-molybdenum catalyst, the sample is decomposed by heating with H_2SO_4. The cooled solution is diluted to volume, and an aliquot containing 10 to 30 mg of cobalt is reacted with measured volumes of potassium ferricyanide and ammonium citrate solutions, ammonia, and petroleum ether. The excess of ferricyanide is then back titrated with a standard cobalt solution. Nickel, phosphorus, silicon, aluminium, and molybdenum do not interfere. Iron, chromium, vanadium, and manganese do interfere.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

55549 (BNWL-SA—6223) **X-ray fluorescence capabilities for uranium ore analysis.** Nielson, K.K.; Wogman, N.A.; Brodzinski, R.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1977. Contract EY-76-C-06-1830. 16p. (CONF-770875—3). Dep. NTIS, PC A02/MF A01.

From 26. annual conference on applications of x-ray analysis; Denver, CO, USA (Aug 1977).

A rapid x-ray fluorescence (XRF) method for the quantitative analysis of uranium in ore and process samples is demonstrated. The method requires no uranium ore standards and provides a relative precision of +-2.5 percent. Particle-size and self-absorption effects are evaluated along with current methods of excitation and detection for M, L, and K series uranium x-rays. Sensitivities and detection limits are comparable using either energy dispersive or wavelength dispersive analysis of uranium L x-rays, and wavelength dispersive analysis of uranium M x-rays for both thick and thin samples. The XRF methods are more sensitive than the analysis of uranium by ^{252}Cf neutron-induced γ-ray analysis or by direct photon analysis of uranium daughters.

55550 (DP-MS—77-75) **Methodology for the determination of environmental ^{129}I and ^{99}Tc.** Anderson, T.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1978. Contract EY-76-C-09-0001. 25p. (CONF-780719—2). Dep. NTIS, PC A02/MF A01.

From Conference of the American Society for Testing Materials; Johnson, VT, USA (9 Jul 1978).

The Savannah River Laboratory is using existing techniques and developing new methodology to determine the environmental impact of the Savannah River Plant with regard to ^{129}I and ^{99}Tc. ^{129}I is determined by neutron activation after the method of Brauer. Activation products are quantified by γ-ray spectroscopy [Ge(Li)] following chemical isolation. ^{125}I is used as a yield tracer. ^{129}I amounts as low as 3.8 fCi can be determined with 30-minute counting times. An isotope dilution method for ^{99}Tc based on a three-stage surface ionization mass spectrometer is being developed. Its chemical isolation scheme ends with the Tc loaded on a single ion-exchange bead for enhanced mass-spectrometric sensitivity. ^{97}Tc will be used as a yield tracer. A lower limit of 0.2 fCi is sought. A modified method using liquid scintillation counting has determined ^{99}Tc in some aqueous samples. These methods have confirmed that ^{129}I and ^{99}Tc can be highly mobile in the aqueous environment, establishing the need for monitoring.

55551 (UCRL—52489) **Introduction to energy-dispersive x-ray fluorescence analysis.** Camp, D.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jun 1978. Contract W-7405-ENG-48. 23p. Dep. NTIS, PC A02/MF A01.

The physical principles of energy dispersive x-ray fluorescence analysis are discussed. A phenomenological description of atomic excitation and the subsequent radiation of x rays on which the physical principles are built, is presented. The atomic shell structure and nomenclature, x-ray nomenclature and energies, x-ray intensities and fluorescence yields, and a brief description of the competing Auger and Coster-Kronig transitions are discussed. Radiation absorption and scattering are also discussed, including photoelectric absorption, coherent radiation scattering, and Compton or incoherent scattering. The condition for obtaining polarized radiation is described and its advantages for massive samples are illustrated. Tables give the energies of many prominent K-, L-, and M-series x rays from $Z = 1$ to $Z = 100$, and theoretical K- and L-series x-ray intensities for even Z from $Z = 10$ to 100.

55552 **Method of measuring the disinteration rate of beta-emitting radionuclide in a liquid sample.** Horrocks, D.L. (to Beckman Instruments, Inc.). US Patent 4,060,728. 29 Nov 1977. Filed date 14 Jun 1976. 12p.

A method of measuring the disintegration rate of a beta-emitting radionuclide in a liquid sample by counting at least two differently quenched versions of the sample is described. In each counting operation the sample is counted in the presence of and in the absence of a standard radioactive source. A pulse height (PH) corresponding to a unique point on the pulse height spectrum generated in the presence of the standard is determined. A zero threshold sample count rate (CPM) is derived by counting the sample once in a counting window having a zero threshold lower limit. Normalized values of the measured pulse heights (PH) are developed and correlated with the corresponding pulse counts (CPM) to determine the pulse count for a normalized pulse height value of zero and hence the sample disintegration rate.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 54577, 54580, 54590, 54595, 54606, 54612, 55929, 56301

55553 (ORNL/TM—6431) **Fluorophotometric determination of uranium: an automated sintering furnace and factors affecting precision.** Strain, J.E. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 33p. Dep. NTIS, PC A03/MF A01.

The fusion furnace consists of four individually controlled, slotted-tube furnaces that automatically dry, sinter and anneal the fluoride or carbonate pellet used in the fluorometric determination of uranium. The furnace operates in air and prepares approximately 90 pellets per hour for fluorometric measurement. The factors that were thought to affect the precision of the method were investigated. The two factors that seem to be the most influential are (1) the manner in which the sample is loaded onto the pellet; and (2) the surface characteristics of the platinum dish in which the pellet is sintered and measured fluorometrically.

55554 (UCRL—52000-78-1, pp 9-15) **Laser-induced molecular fluorescence for chemical analysis.** Richardson, J.H. Jan 1978.

In Energy and technology review.

Optical fluorescence, long a tool for chemical analysis, is not sensitive and selective enough to satisfy new and complex requirements in such varied areas as flow cytometry, uranium trace detection, and rainout studies. We are developing laser fluorescence analysis to fill this analytical gap. We have consistently improved the limits of detection for numerous compounds by tenfold to a thousandfold. We have found numerous research and programmatic applications for this newly developed analytical capability.

55555 **Differential photometric determination of silicon dioxide in solid fuel ash and slag.** Novitskii, N.V.; Ivanova, N.I. *Khim. Tverd. Topl.;* No. 5, 85-89(Sep 1977). (In Russian).

The method described is based on the light absorption of a reduced silicon-molybdenum system.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 54608, 54672

55556 **Thermodynamics of synergistic solvent extraction of zinc(II).** Nash, K.L.; Choppin, G.R. (Florida State Univ., Tallahassee). *J. Inorg. Nucl. Chem.;* **39**: 131-135(1977).

The thermodynamics of the synergistic solvent extraction of zinc(II) by HTTA-TBP mixtures were studied using radiochemical techniques. The thermodynamic values of the extraction equations indicate that the mechanism of adduct formation by TBP with the $Zn(TTA)_2$ chelate involves expansion of the coordination number of the central metal ion from 4 to 5. The extraction of zinc(II) by HDEHP-TBP mixtures was also studied but no synergistic effect was seen in this extraction system.

INORGANIC AND PHYSICAL CHEMISTRY

55557 **Modification of an oxygen bomb calorimeter to measure enthalpies of reaction of liquid metals.** Carling, R.W. (Sandia Laboratories, Livermore, California 94550). *Rev. Sci. Instrum.;* **49**: No. 10, 1489-1490(Oct 1978).

Modification of a commercially available oxygen bomb calorimeter is described. This modification permits direct determination of the enthalpies of reaction of liquid metals that have melting points below about 310 K.

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 54272, 54558, 54785, 55828

55558 (AD-A—050776) **Reaction schemes for dinuclear compounds containing metal-to-metal triple bonds illustrated by recent findings in the chemistry of molybdenum and tungsten. Technical report.** Chisholm, M.H. (Princeton Univ., NJ (USA). Dept. of Chemistry). 14 Feb 1978. Contract N00014-76-C-0826. 22p. (TR—78-08). NTIS PC A02/MF A01.

A number of general modes of reaction are proposed for compounds containing homonuclear metal-to-metal triple bonds. These are discussed in the light of recent experimental observations. (Author)

55559 (AD-A—050968) **Theories of energy disposal in chemical reactions. Final report 1 Jun 73-30 Jun 77.** Kuppermann, A. (California Inst. of Tech., Pasadena (USA). Div. of Chemistry and Chemical Engineering). Feb 1978. 192p. NTIS PC A09/MF A01.

Accurate and approximate quantum dynamical calculations on elementary chemical reactions of importance for the fundamental aspects of chemical dynamics and for advanced technologies of interest to the US Air Force, such as high energy chemical lasers, plume technology, and the chemical effects of high energy radiation, were performed. These included calculations of three-atom exchange reactions, breakup collisions, three-body recombinations, vibrational quenching by reaction, resonances, and electronic branching ratios. The aim of these calculations was to develop an understanding of these processes and to develop benchmark data against which approximate methods could be tested. (Author)

55560 **Standard test method for solubility of fixed gases in low-boiling liquids.** *Annu. Book ASTM Stand.;* No. 25, 268-275(1977). ANSI/ASTM-D—3429-75.

Solubilities of nonreactive gases such as N_2 and He in liquids that boil below 0°C can be determined by vaporizing the sample in an evacuated sample container at room temperature. The concentration of the gas in the original sample is determined by gas chromatography after vaporization of the liquid sample. The method is applicable only if the molar concentration of the gas is the same in the sample container as in the original liquid.

55561 (LBL—8003) **Effect of CO_2 on the oxide decomposition products of calcite.** Ewing, J.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1978. Contract W-7405-ENG-48. 51p. Dep. NTIS, PC A04/MF A01.

Thesis.

Calcium carbonate powder was decomposed isothermally at 700°C in vacuum and in CO_2 pressures from 0.1 to 9.0 torr. The surface area, crystallinity, and morphology of the calcium oxide product were evaluated. Calcite decomposed in CO_2 pressures less than 0.9 torr produced linear plots of surface area in m^2/mole vs mole percent CaO for each pressure studied, and there was no change in apparent particle shapes. A high degree of line broadening was exhibited by x-ray diffraction patterns of the product from vacuum decomposition. Calcite decomposed in a 9.0 torr CO_2 pressure produced a calcium oxide of very low surface area that exhibited no line broadening. At this high CO_2 pressure, significant changes in the surface morphology were observed which indicated the occurrence of considerable sintering, and possibly the formation of a $CaCO_3$-CaO eutectic liquid.

55562 Thermodynamics of electrolytes. XI. Properties of 3:2, 4:2, and other high-valence types. Pitzer, K.S.; Silvester, L.F. (Univ. of California, Berkeley). *J. Phys. Chem.;* **82**: No. 11, 1239-1242(1 Jun 1978).

Various thermodynamic properties are considered for very high-valence 3:2 and 4:2 electrolytes in water at room temperature. These solutions show the behavior described by Davies in which ion pairing arises as the concentration increases followed by redissociation at still higher concentrations. Heat of dilution data, which extend below 10^{-4} M, is interpreted with the same form of equation used earlier for 2:2 electrolytes. Activity and osmotic coefficient data do not extend to low enough concentration for independent interpretation, but they are treated with the aid of conductance data in the more dilute range. Parameters are reported for $Al_2(SO_4)_3$, $La_2(SO_4)_3$, $In_2(SO_4)_3$, and several cyanoferrates. 2 figures; 1 table.

55563 Detailed calculations of multiple steady states during oxidation of cerous ion by bromate in a stirred flow reactor. Bar-Eli, K.; Noyes, R.M. (Univ. of Oregon, Eugene). *J. Phys. Chem.;* **82**: No. 12, 1352-1359(15 Jun 1978).

Under certain conditions, addition of acidic bromate, bromide, and cerous ion solutions to a stirred flow reactor can generate two different locally stable steady states for the same input conditions. We have used a mechanism developed previously to calculate effects to be expected for various inputs of reactants and total flow rates. The calculations suggest specific experimental tests that would support or invalidate the proposed mechanism and refine rate constants assigned to specific steps. 1 table; 8 figures.

55564 Standard test method for foam in aqueous media (blender test). *Annu. Book ASTM Stand.;* No. 25, 287-290(1977).

ANSI/ASTM-D—3519-76.

The measurement of the increase in volume of a low-viscosity aqueous liquid due to its tendency to foam under high shear conditions is described. The test fluid is blended using a commercial-type blender with glass jar at 25 +- 1°C agitating between 4000 and 13,000 rpm. The increase in volume is determined by the increase in height of the test fluid. The measurement is applicable to determining the foaming tendency of a water-based metalworking coolant.

55565 Standard test method for spontaneous heating values of liquids and solids (differential Mackey test). *Annu. Book ASTM Stand.;* No. 25, 304-307(1977).

ANSI/ASTM-D—3523-76.

A method for the determination of the spontaneous heating value (SHV) of liquids and solids supported on cellulosic surfaces is described. The magnitude of the measured temperature difference is a semiquantitative indication of the enthalpy and rate of reaction of the sample material. The apparatus and its calibration is described. The sample is supported on surgical gauze (liquid samples are absorbed on the gauze, and solid samples are rolled in the gauze) and placed in a heated chamber. The temperature of the sample is compared to that of an equal quantity of gauze contained in an identical chamber. The system is allowed to reach equilibrium, and the temperature readings are recorded for at least 4 h. Equations are given for calculation of the temperature difference found at the maximum temperature, and this calculated value is reported as the SHV of the sample at the initial reference temperature.

55566 Standard test method for foam in aqueous media (bottle test). *Annu. Book ASTM Stand.;* No. 25, 328-331(1977).

ANSI/ASTM-D—3601-77.

A procedure is described for determining the tendency of a low-viscosity aqueous liquid to foam under low shear conditions. The increase in volume due to the tendency to foam is determined by the increase in total height of the test fluid in a 16-oz screw neck bottle after vigorous shaking of the emulsion at 25 +- 1°C. The measurement is applicable to determining the foaming tendency of a water-based metalworking coolant.

55567 Autocorrelation spectroscopy of nickel chloride aqueous solutions. Sorensen, C.M.; Scott, J.F. (Univ. of Colorado, Boulder). *J. Phys., C (London);* **10**: L115-L119(1977).

Intensity autocorrelation spectroscopy measurements have been made on aqueous solutions of nickel chloride as a function of wavevector and molarity. No long-range order is observed on a 10^{-5} s time scale. A k^2 dependence is observed, indicating Gaussian diffusion. The particle size is found to be 2 A; and the correlation time varies linearly with the shear viscosity of the solutions. The particles are interpreted to be $NiCl_2$ molecules, having vibrational energies of approximately 200 cm^{-1}.

ISOTOPE EFFECTS

55568 (AD-A—050192) **Kinetic study of h + hf(v = 3); kinetic isotope effect and temperature dependence. Interim report.** Bott, J.F.; Heidner, R.F. III. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 27 Jan 1978. Contract F04701-77-C-0078. 40p. (TR—0078(3603)-1). NTIS PC A03/MF A01.

Rates of HF(v = 3) removal by H and D atoms were measured between 200 and 295 K in a laser-induced fluorescence-discharge flow-tube apparatus. The removal rates by H atoms were found to increase from 6.3 x 10 to the 13th power cu. cm/mol-sec at 295 K to 10 to the 14th power cu. cm/mol-sec at 200 K. The removal of HF(v = 3) by D atoms is somewhat slower, but the removal rates have a similar negative temperature dependence. There are several mechanisms by which H atoms can remove HF(v = 3), i.e., reaction to form H_2 + F or deactivation to HF(v = 0, 1, or 2) with or without exchange of the F atom. The several possibilities are discussed and compared to theoretical calculations.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 54676

55569 Process for laser isotope separation. Robinson, C.P.; Rockwood, S.D.; Jensen, R.J.; Lyman, J.L.; Aldridge, J.P. (to Energy Research and Development Administration, Washington, D.C. (USA)). French Patent 2,308,403/A/. 22 Apr 1976. Priority date 22 Apr 1975, United States of America (USA). 20p. (In French).

This invention concerns isotopic separation and enrichment processes and specifically the isotopic enrichment processes in which the molecular species containing a particular isotope are excited selectively by an infra-red laser radiation with a sufficiently high level of excitation to trigger off the chemical reactions, whilst the non-excited molecules of the species do not undergo these reactions. According to the process of the invention, BCl_3 is highly enriched in ^{10}B by irradiating a mixture of natural BCl_3 and gaseous hydrogen with an intense luminous beam from a CO_2 laser working in pulses. In an analogous manner, SF_6 is highly enriched in ^{34}S by the irradiation of a mixture of natural SF_6 and gaseous hydrogen with an intense luminous beam from a CO_2 laser working in pulses.

ORGANIC CHEMISTRY

REFER ALSO TO CITATION(S) 54795, 56321

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 54542, 54543, 54545, 54558, 54790, 55581

55570 (AD-A—048886) **Reactions of triply-bonded dimetal compounds. Reversible addition of carbon monoxide to a hexakis(alkoxy) dimolybdenum compound. A molecule with a carbonyl-bridged metal-to-metal double bond. Technical report.** Chisholm, M.H.; Cotton, F.A.; Extine, M.W.; Kelly, R.L. (Princeton Univ., NJ (USA). Dept. of Chemistry). 4 Jan 1978. Contract N00014-76-C-0826. 11p. NTIS PC A02/MF A01.

The dinuclear alkoxides, Mo2 (OR) 6, which contain metal-to-metal triple bonds, react with carbon monoxide at room temperature and 1 atm. A reversible reaction has been established for R=Bu: Mo2 (OBut) 6+ CO Mo2 (OBut) 6 CO. The compound Mo2(OBut) 6 CO has been structurally characterized and shown to contain a carbonyl-bridged metal-to-metal double bond. The Mo-to-Mo distance is 2.489 A. In the presence of an excess of CO, Mo(CO) 6 is ultimately formed along with other as yet, uncharacterized molybdenum containing compounds.

55571 (AD-A—050638) **Compatibilization of polyphenylquinoxaline with other polymers using chloroform as the solvent in the preparation of polymeric membranes. Compatibility study report Dec 76-Jun 77.** Angres, I. (Naval Surface Weapons Center, Silver Spring, MD (USA)). 16 Nov 1977. 8p. (NSWC/WOL/TR—77-118). NTIS PC A02/MF A01.

This work was performed to determine if polyphenylquinoxaline (PPQ) can be made compatible with other

polymers such as polyvinylacetate, polyvinylpyrrolidone, vinylpyrrolidone/vinylacetate copolymer, cellulose acetate, cellulose triacetate, and polybrene. The primary purpose was to prepare homogeneous solution blends containing PPQ combined with one, two or three of the above polymers. Such solution blends were used to prepare polymeric membranes to be used as battery separators. (Author)

55572 Synthesis of thiocarbonyl-bridged (eta^5-C_5H_5)$_2$Fe$_2$(CO)$_3$(CS) and crystal structure of an S-alkylated derivative. Wagner, R.E.; Jacobson, R.A.; Angelici, R.J.; Quick, M.H. (Ames Lab., IA). *J. Organomet. Chem.;* **148**: C35-C39(1978).

The reaction of $CpFe(CO)_2^-$ with $(PhO)_2C{=}S$, a new method of introducing a thiocarbonyl bridging ligand into a metal complex, yielded $Cp_2Fe_2(CO)_3(CS)$. The molecule exists as a cis-trans mixture in solution as evidenced by IR and NMR studies. On reaction with a variety of alkyl halides or other alkylating agents, stable S-alkyl derivatives are formed. The x-ray structure of $[Cp_2Fe_2(CO)_3(CS{-}Et]BF_4$ is reported, and the nature of the bonding of the unusual $CS{-}Et^+$ bridging group is discussed.

55573 Adsorption of benzene and toulene on mercury. Baikerikar, K.G.; Hansen, R.S. (Ames Lab., IA). *J. Colloid Interface Sci.;* **61**: No. 2, 239-248(Sep 1977).

The electrochemical adsorption of benzene and toluene on a mercury electrode was investigated from different aqueous background electrolyte solutions. The experimental techniques employed were capillary electrometer and impedance bridge. The interfacial tension data obtained from perchloric acid solutions were employed for fitting to the Frumkin equations and parameters of adsorption were obtained. The anomalous behavior of capacity at anodic polarization appears to be associated with specific interaction between anion adsorption and organic solute adsorption; anodic capacity peaks are absent in the presence of perchlorate and iodide ions but not in the presence of sulfate and chloride ions.

55574 New potting material: expandable polystyrene bead foam. Fossey, D.J. (Bendix Corp., Kansas City, MO); Smith, C.H.; Wischmann, K.B. *J. Cell. Plast.;* **13**: No. 5, 347-353(1977).

Many present-day electronic packages are designed using sophisticated and expensive circuitry. A potting material that could be easily removed with common solvents was needed to reduce the cost and time of reworking defective components in these units. Polystyrene bead foam (PSBF) appeared to have several advantages over conventional encapsulants such as rigid polyurethane foam and filled epoxy compounds for this application. The density of the PSBF can be readily adjusted from 0.02 g/cm^3 to 0.60 g/cm^3 and easily dissolved in most hydrocarbon solvents with minimal damage to other plastic parts and electrical components in the unit. In addition, it is relatively inexpensive, requires very little clean-up, and is an excellent shock absorbing material.

55575 Neutron diffraction refinement of the crystal structure of β-maltose monohydrate. Gress, M.E.; Jeffrey, G.A. (Brookhaven National Lab., Upton, NY). *Acta Crystallogr., Sect. B;* **33**: 2490-2495(1977).

Single crystal neutron diffraction data on β-maltose monohydrate have provided an accurate description of the hydrogen bonding, which consists of a finite chain intersecting two infinite chains. With the exception of an intramolecular hydrogen bond (H . . . O = 1.835 A), the hydroxyl interactions are all of the donor/acceptor type (. . . O—H . . . O). The shortest bonds are those to the water molecules (1.762 and 1.798 A). The remainder range from 1.812 to 1.927 A, the shortest being that from the β-anomeric hydroxyl. The α- and β-glucopyranose residues have small dimensional differences in their ring torsion angles, C—O bond lengths and ring-oxygen valence angles, which are analogous to those observed in the α- and β-pyranose monosaccharides. 7 tables, 4 figs.

55576 Frequency dependence of capacitance at the desorption potentials or organic molecules. Hansen, R.S.; Baikerikar, K.G. (Ames Lab., IA). *J. Electroanal. Chem.;* **82**: 403-412(1977).

A theory on kinetics of adsorption is presented which assumes that diffusion is the sole rate determining step in adsorption. The impedance of the electrical double layer is modelled as a capacitor and resistor in series and equations have been derived relating capacity to frequency. The theory has been tested using capacity data obtained at anodic desorption peak maxima of two neutral organic adsorbates (hexanoic and valeric acids) and found to agree reasonably with experimental results.

55577 Coexistence curve of a binary mixture. Jacobs, D.T.; Anthony, D.J.; Mockler, R.C.; O'Sullivan, W.J. (Univ. of Colorado, Boulder). *Chem. Phys. (Amsterdam);* **20**: 219-226(1977).

Precise measurements of the refractive index are reported as a function of temperature in the one- and two-phase region near the consolute point in the binary mixture methanol-cyclohexane. By means of forty-four data points over four decades in epsilon = (T/sub c/ - T)/T/sub c/, 6 x 10^{-6} < epsilon < 6 x 10^{-2}, the coexistence curve was determined and the critical exponent β found to be 0.326 + 0.003 by using a properly weighted least squares fit to the data. The uncertainty is three times the standard deviation. Our data are consistent with other refractive index data of the same binary fluids although a different value for the critical exponent was found. The Wegner type correction terms reported by others recently are not needed, and an anomaly in the rectilinear diameter is not seen.

55578 Zeolite hydrodesulfurization catalysts. Vysotskii, A.V.; Chuikova, N.A.; Lipovich, V.G. (Irkutsk State Univ., USSR). *Kinet. Catal. (USSR) (Engl. Transl.);* **18**: No. 5, 1106-1107(1977).

Translated from Kinet. Katal.; 18: No. 5, 1345-1347(1977).

The catalytic activity in the hydrodesulfurization reaction of type A, L, X, Y zeolites and mordenite, modified with cobalt and nickel and impregnated with molybdenum salts in the ratio Co (Ni) : Mo = 0.2-2.5, was studied by the pulse microcatalytic method. It was established that Ni-Mo and Co-Mo zeolites of type X and Y achieve conversion of thiophene to a mixture of butenes and butanes. Addition of Co-Mo zeolites of type X and Y (Co : Mo = 1.8-2.5) to commercial samples of Al-Co-Mo (ACM) and Al-Ni-Mo (ANM) decreases the activity of ACM in hydrodesulfurization of thiophene, while introduction of the zeolite 0.9 NiX/MoO_3 (Ni : Mo = 2.2) increases the activity of ANM by two times. Type A, L zeolites and mordenite having a high content of active metals are catalytically inactive.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

55579 (LA-UR—78-1583) **One-carbon ^{13}C-labeled synthetic intermediates. Comparison and evaluation of preparative methods.** Ott, D.G. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 23p. (CONF-780501—5). Dep. NTIS, PC A02/MF A01.

From 3. international conference on stable isotopes; Oak Brook, IL, USA (23 May 1978).

Frequently the biggest stumbling block to the synthesis of a structurally complex labeled compound is obtaining the required low molecular weight, structurally simple, isotopic intermediates. Selection of a particular scheme from various alternatives depends on the available capabilities and quantity of product desired, as well as on anticipated future requirements and need for related compounds. Many of the newer reagents for organic synthesis can be applied effectively to isotopic preparations with improvements of yields and simplification of procedures compared to established classical methods. New routes developed for higher molecular weight compounds are sometimes not directly adaptable to the one-carbon analogs, either because of isolation difficulties occasioned by physical properties or by chemical reactivities peculiar to their being first members of homologous series. Various routes for preparation of carbon-13 labeled methanol, formaldehyde, and cyanide are compared.

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 55398

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 55828, 55829

55580 High-power infrared laser chemistry. Fuss, W.; Kompa, K.L.; Proch, D.; Schmid, W.E. (Projektgruppe fuer Laserforschung der Max-Planck-Gesellschaft, Garching, Ger.). pp 235-244 of Lasers in chemistry. West, M.A. (ed.). Amsterdam; Elsevier Scientific Publishing Co. (1977).

The role of highly vibrationally excited molecules in laser photochemistry is discussed on the general background of laser applications to molecular excitation. Particular attention is given to the new phenomenon of multiple photon excitation (infrared vibrational "superexcitation"). Some new results are presented for both the energy dependence and frequency dependence of the cross-sections of absorption and dissociation in an intense laser field.

RADIATION CHEMISTRY

55581 Temperature dependence of electron scavenging in ethanol and ethanol-O-d. Razem, D.; Hamill, W.H. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **82**: No. 12, 1347-1351(15 Jun 1978).

Inefficient scavenging of solvated electrons (e$^-$/sub s/) may provide understanding of details which are difficult to explore for nearly diffusion-controlled processes. Alcohols as solvents permit use of organic reagents, exhibit interesting dynamic solvation effects, and are particularly appropriate for dry-electron scavenging. Sixteen

scavengers, with k/sub e/sub aq$^-$// in the range 10^7 to 10^9 M^{-1} s^{-1}, have been investigated in ethanol from 150 to 298 K. Values of the activation energy were higher for two efficient scavengers, approximately 4.5 kcal/mol for CCl_4 and $HClO_4$, than approximately 3.8 kcal/mol for inefficient scavengers such as toluene, with no evident pattern. Activation contributes little to differences in k/sub e$^-$/sub s//. Many of the inefficient scavengers were moderately efficient as dry-electron (e^-) scavengers at 298 K. For toluene 63% of dry electrons were scavenged at 298 K by C_{37} = 1.8 M, but at 123 K by only C_{37} = 0.43 M. Temperature-dependent ionization $C_6H_5CH_3^- \rightarrow C_6H_5CH_3 + e^-$/sub s/ is indicated. At 298 K and large combined concentrations of toluene (k/sub e$^-$/sub s// approximately equal to 10^7 M^{-1} s^{-1}) and biphenyl (k/sub e$^-$/sub s// approximately equal to 10^9 M^{-1} s^{-1}), toluene converts e^- to e$^-$/sub s/, measured as biphenylide ion. Localization of e^- by solvent, which is less efficient in C_2H_5OD, competes with scavenging and C_{37} decreases with decreasing temperature to a constant limiting value at approximately 150 or approximately 125 K which is approximately 25 to 50% of the value at 298 K. Localization and scavenging are activationless at low temperature and the isotope effect disappears. It is proposed that e^- scattering in the liquid maintains a large zero-point kinetic energy which is available for resonances, e.g., benzene, to account for activationless scavenging. Analogously, localization is attributed to $C_2H_5OH^-$. 1 table; 9 figures.

55582 CIDNP in pulse radiolysis of aqueous dimethyl sulfoxide. Nelson, D.J. (Argonne National Lab., Il). *J. Phys. Chem.;* **82**: No. 12, 1400-1403(15 Jun 1978).

Variable field CIDNP in pulse radiolysis of aqueous dimethyl sulfoxide is described. The products of radiolytically produced radicals are identified, and the radical pair model of CIDNP is applied in analysis of the observed polarization. Various mechanisms of radical formation and reaction are considered. 4 figures; 2 tables.

55583 Kinetics of radical decay. VI. Radical pairs in x-irradiated polycrystalline n-alkoxyazoxybenzenes at low temperature. Tria, J.J.; Johnsen, R.H. (Florida State Univ., Tallahassee). *J. Phys. Chem.;* **82**: No. 11, 1235-1239(1 Jun 1978).

ESR studies indicate that about 70% of the radicals formed by X-radiolysis of polycrystalline samples of n-alkoxyazoxybenzenes at 77 K are produced as closely spaced pairs. Upon warming, the radicals in pairs combine leaving behind a smaller population of chemically different independent radicals. Good correlation between the yield of N_2 gas ($G(N_2)$ = 0.021) and the yield of radical pairs (G(pairs) approximately 0.02) in p-azoxyanisole (PAA), as well as spectral differences in deuterated samples and other considerations, indicate the pairs are probably formed by an intramolecular process involving destruction of the azoxy linkage to leave two substituted phenyl radicals separated by a light gas molecule. Overall radical pair decay is "stepwise." Plots of fractional decay vs. time for different doses indicate that pair decay is a correlated process; the method of initial rates gives a reaction order of 0.9 and activation energy 2.7 kcal/mol for recombination in p-azoxyphenetole (PAP); and the pair separation distance is constant during decay, all indicating that the decay occurs by a single jump recombination process involving geminate partners. 1 table; 8 figures.

55584 Decomposition of organic substances by ionizing radiations. Dole, M. (Baylor Univ., Waco, TX). *Prepr., Div. Pet. Chem., Am. Chem. Soc.;* **23**: No. 2, 429-432(Mar 1978). (CONF-780305—P1).

From American Chemical Society conference; Anaheim, CA, USA (12 Mar 1978).

This brief review summarizes and discusses the mechanism of decomposition reactions produced by ionizing radiation, usually electrons up to 1 MeV or ^{60}Co γ rays 1.1 and 1.3 MeV. Hexane, 1-hexene, ethanol, diethyl ether, and acetone are considered as examples of alkanes, alkenes, and organic oxygen compounds; product yields are tabulated. (DLC)

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 55900

55585 (AD-A—048814) **Fine definition of ir spectra for certain metallic oxide species. Final report, 1 July 1975—30 September 1976.** Green, D.W.; Reedy, G.T. (Argonne National Lab., IL (USA)). Jun 1977. 27p. NTIS PC A03/MF A01.

The reactions between U, UO or UO2 and NO or NO2 have been studied by cocondensation of the reactants in Ar matrices at 14 K. Infrared spectra of the species in the matrices were recorded with a Fourier transform spectrometer. The vibrational mode frequencies of several new species were identified by use of isotopic substitution. The UO2(+) ion was produced by three different reactions and was found to be linear. The nitrides of uranium, UN and UN2, were produced by two methods; UN2 was found to be linear. The species UO(+) could not be produced in sufficient quantities to be observed by any of the following reactions: U NO2, U NO or UO I.

55586 (BNWL-SA—6450) **Planning for decommissioning and decontamination of Hanford nuclear facilities.** Litchfield, J.W.; King, J.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1977. Contract EY-76-C-06-1830. 47p. (CONF-771102—26). Dep. NTIS, PC A03/MF A01.

From 20. annual AICHE meeting; New York, NY, USA (13 Nov 1977).

The 570-square mile Hanford Project contains facilities with varying degrees of radioactive contamination as a result of plutonium production operations. With the evolution of production requirements and technology, many of these have been retired and will be decommissioned and decontaminated (D and D). Planning for D and D at Hanford requires identification and characterization of contaminated facilities, prioritization of facilities for decommissioning, selection of D and D modes, estimating costs and other characteristics of D and D activities, definition of future scenarios at Hanford, and preparation and assessment of plans to achieve defined scenarios. A multiattributed decision model using four criteria was used to prioritize facilities for decommissioning. A computer-based interactive planning system was developed to facilitate preparation and assessment of D and D plans.

55587 (CONF-780715—1) **Telluro amino acids-synthesis, characterization and properties of a new and potentially useful class of compounds.** Knapp, F.F. Jr.; Ambrose, K.R.; Callahan, A.P. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 2p. Dep. NTIS, PC A02/MF A01.

From 2. symposium on radiopharmaceutical chemistry; Oxford, UK (3 Jul 1978).

The Te-123m nuclide emits 159 keV photons suggesting that agents labeled with this nuclide would be attractive candidates for tissue imaging. Amino acids labeled with Te-123m are of particular interest since some of these compounds would be isosteric with the sulfur analogs and might behave similarly in vivo. Such agents could possibly be useful for pancreatic imaging and for other biomedical applications. The goal of this investigation was to develop a general chemical method for the preparation of telluro amino acids. Attempts by other workers to prepare such compounds by microbiological methods have been unsuccessful. Since telluro amino acids were unknown prior to our studies we attempted the synthesis of a representative member of this class of compounds by several routes. Two general approaches were considered which involved either the introduction of an (organo telluro) reagent into a substrate that contained the protected -$CH(NH_2)COOH$ moiety or introduction of the reagent into a substrate that could subsequently be converted to the α-amino acid after the coupling step.

COMBUSTION CHEMISTRY

55588 (AD-A—049198) **Thermodynamics of organic compounds. Final report, 1 October 1976—30 September 1977.** Good, W.D.; Scott, D.W.; Smith, N.K.; Osborn, A.G. (Energy Research and Development Administration, Bartlesville, OK (USA). Bartlesville Energy Research Center). 30 Sep 1977. 20p. NTIS PC A02/MF A01.

Research continued on hydrocarbons with unusual strained bridging bonds that may contribute knowledge needed to tailor organic molecules having good energy/volume or energy/mass characteristics. Three compounds were studied containing the 'cyclo-buta' bridge, a study commenced in FY 76. A study was begun on certain alkylnaphthalenes and indans in which high steric interaction energy should contribute to high enthalpy of combustion. Two ram-jet fuels were studied, fuels already in use. (Author)

55589 (AD-A—049217) **Studies in rotational flows especially asymptotic methods. Final report, 1 November 1974—15 September 1977.** Ludford, G.S.S. (Cornell Univ., Ithaca, NY (USA). Center for Applied Mathematics). Oct 1977. 10p. NTIS PC A02/MF A01.

Modern asymptotic methods have been used to investigate (i) combustion, in particular monopropellant decomposition in inert and reactive atmospheres, fuel-drop burning, quenching of plane deflagration waves, burning of solids and liquids, separated flames, slowly varying flames (e.g. in ducts), flame stretch, stability, quenching of multi-dimensional flames and chambered diffusion flames; (ii) entry flow and inertial effects in magnetohydrodynamic ducts under strong transverse magnetic fields; (iii) viscous sheets advancing over dry beds. Details of the results are contained in the 28 Technical Reports and 3 Theses.

55590 (AD-A—050309) **Coherence retention during rotationally inelastic collisions of selectively excited diatomic sulfur.** Caughey,

T.A.; Crosley, D.R. (Ballistic Research Labs., Aberdeen Proving Ground, MD (USA)). Oct 1977. 32p. (BRL—2021). NTIS PC A03/MF A01.

There is ample experimental evidence for the presence of non-equilibrium population distributions, and the occurrence of non-Arrhenius reaction rate behavior, in a wide variety of combustion processes. A full understanding of such systems on a microscopic level requires that such effects be addressed. Recent experiments are now just beginning to provide information on the detailed quantum level dependence of inelastic and reactive collisions for a number of small molecules. However, the difficulty involved in carrying out such experiments means that theoretical computations of such rates will continue to be important for a number of systems. It is in turn crucial to have at hand experimental evidence concerning details of the collision dynamics which place constraints upon the theoretical formulations.

55591 Combustion efficiency through use of flue gas analyzers. Richardson, D.M. (Thermco Instrument Corp., LaPorte, IN). *Ind. Heat. (Pittsburgh);* **45**: No. 5, 20-21(May 1978).

To help eliminate wasteful combustion, gas analyzers have been employed for over seventy years. The first flue gas analyzer was an orsat (chemical) type developed by Joseph W. Hays in the early 1900's. By analysis of the products of combustion, the operator can understand what is taking place during the burning. Combustion gas analyzers may be separated into two broad categories; those that utilize chemicals for taking a momentary reading, and those that are electronic for taking a continuous reading. Chemical analyzers may analyze CO, CO_2 or O_2, but CO_2 is most commonly analyzed. With these analyzers, the flue gas is introduced into the analyzer with a hand pump, after which the flue gas enters a liquid chemical. The chemical has the ability to selectively absorb the gas being analyzed, and the operator reads the corresponding change in flue gas volume on a calibrated tube. Electronics analyzers may be distinguished by the method and product of combustion, CO_2, CO and H_2, or O_2, being detected. One type, based on CO_2 reading, is equipped with a flue gas filter, an internal pump for continuously drawing a sample, and a gas detector that measures the thermal conductivity of the flue gas against that of air. The thermal conductivity change is converted to CO_2% and read out on a meter. Another type has a filter and continuous pump also. The flue gas is drawn past a detector cell where the O_2 present in the flue gas chemically combines with an electrolyte, producing a voltage proportional to the O_2 concentration.

55592 Study of the combustion of individual drops of sulfur in stationary cold air. Shelyakin, A.P.; Kaposhin, I.S. *J. Appl. Chem. USSR (Engl. Transl.);* **2**: No. 2, 393-395(Feb 1977).

Translated from Zh. Prikl. Khim.; 50: No. 2, 416-418(Feb 1977).

The combustion of individual drops of S in air at room temperature was studied. It was found that there are three distinct periods of combustion. The length of the period of intensive combustion is proportional not to the square but to the cube of the initial diameter of the drop of sulfur. The period of intensive combustion is decisively affected by explosions within the drop leading to outbursts of flame. The cause of the explosion is the intensive evaporation of the drop under the evolution of heat by the decomposing polymer. (JRD)

55593 Further calculations based upon a theory of flame spread across solid fuels. Feng, C.C.; Sirignano, W.A. *Combust. Flame;* **29**: No. 3, 247-263(1977).

A theory of flame spread above solid fuel beds of finite or infinite thickness is considered. Heat transfer ahead of the flame is allowed through both the solid and gas phases. The simplifying assumption of a surface reaction is made. Temperature profiles in both phases, concentration profiles in the gas phase, heat transfer at the surface, and flame spreading rates are determined. It is found that chemical kinetic parameters together with transport properties strongly influence the spreading rate. Heat transfer through the gas phase is the dominant mechanism for energy transfer ahead of the spreading flame over a wide range of Peclet numbers for the gas and solid phases.

ENGINEERING

GENERAL ENGINEERING

55594 (UCRL-Trans—11397) **Analysis of the propagation of elastic—plastic waves in short rods.** Gulidov, A.I.; Fomin, V.M. Jul 1978. Translated from pp 58-61 of Nelineinye volny deformatsii, Tallin, 1968. 7p. Dep. NTIS, MF A01.

Portions of document are illegible.

The phenomenon of recoil of solid bodies has been studied previously in its elastic-plastic statement at various velocities in. An explanation is given of the physics of the phenomenon, produced on the basis of one-dimensional theory. In this work, using the example of the solution of the problem of the impact of a rod against a rigid barrier, the phenomenon of recoil is studied in its two-dimensional statement. It is shown that the qualitative theory of the process of recoil suggested earlier is applicable to this case.

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 54677, 55054, 55808

55595 (CONF-780609—12) **Comparison of ICEPEL predictions with single elbow flexible piping system experiment.** A-Moneim, M.T.; Chang, Y.W. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 32p. Dep. NTIS, PC A03/MF A01.

From ASME/CSME pressure vessels and piping conference; Montreal, Canada (25 Jun 1978).

The ICEPEL Code for coupled hydrodynamic-structural response analysis of piping systems is used to analyze an experiment on the response of flexible piping systems to internal pressure pulses. The piping system consisted of two flexible Nickel-200 pipes connected in series through a 90° thick-walled stainless steel elbow. A tailored pressure pulse generated by a calibrated pulse gun is stabilized in a long thick-walled stainless steel pipe leading to the flexible piping system which ended with a heavy blind flange. The analytical results of pressure and circumferential strain histories are discussed and compared against the experimental data obtained by Stanford Research Institute.

55596 Optimisation of thin-walled pipes. Optimum dimensioning of pipes in connection with strong superposed axial forces, or bending and torsional moments. Troost, A.; El-Magd, E. (Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Werkstoffkunde). *Baender, Bleche, Rohre;* **19**: No. 4, 169-172(Apr 1978). (In German).

A procedure is described for optimal dimensioning of thin-walled pipes which are subjected to internal pressure, axial forces, bending moments or torsional moments by minimizing the pipe mass per unit length.

55597 Particulate sampling from turbulent gas streams. Benarie, M.M. (Institut National de Recherche Chimique Appliquee (IRCHA), 91 - Vert-le-Petit (France)). *Staub-Reinhalt. Luft;* **38**: No. 2, 69-70(Feb 1978).

55598 Comparison of the methods for stress calculation of thick-walled vessels under thermal stress. Schnell, W.; Akasoy, S. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Mechanik). *Konstr. Masch., Appar. Geraetebau;* **30**: No. 2, 45-52(Feb 1978). (In German).

For typical components (disc, plate, shell) and combinations of them (cylindrical vessel with a flange) the stresses are computed according to the three-dimentsional theory with special finite elements. Comparison with the results of the classical (two-dimensional) theory show in what dimensional zones the more expensive calculation has to be applied. For this purpose, steady and unsteady temperature fields, symmetrical with respect to rotation, have been assumed as the load, the time discretion being carried out according to the method of differnence equations or the Galerkin method.

55599 Nondestructive measurements of residual stresses on turbine and generator shafts. Buehler, H.; Siebert, D. (Technische Univ. Hannover (Germany, F.R.). Inst. fuer Umformtechnik und Umformmaschinen). *Arch. Eisenhuettenwes.;* **48**: No. 11, 595-600(Nov 1977). (In German).

The following topics are discussed: the cam method for measuring residual stresses on shafts of quenched and tempered Cr-Mo-Ni steel. Determination of the residual stresses in the surface layers on tangential circumferential ribs; testing the cam method in industrial operation by measurements on a larger scale; thehe extent of the residual stresses and their dependence on the shaft diameter; and the rotationally symmetric distribution of the residual stresses and their change in longitudinal direction of the shafts.

55600 Heat transfer device. Brost, O.; Schubert, P.; Groll, M.; Zimmermann, P. (to Institut fuer Kerntechnik und Energiewandlung e.V., Stuttgart (Germany, F.R.)). German(FRG) Patent 2,350,980/C/. 23 Jun 1977. 4p. (In German).

A heat transfer device, a so-called gas-stabilized heat pipe, will be improved in efficiency by a connecting pipe beginning in the gas reservoir, passing through the chamber in axial direction, and provided with openings in the heating and cooling section. By this it is intended to achieve a very precise control of the operating temperature, independent of the direction of heat transport. It is of

advantage to provide the connecting pipe as well as the gas reservoir with a capillary structure on their inner surfaces.

55601 Actuator. Brandelik, A. (to Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). German(FRG) Patent 2,547,743/A/. 14 Apr 1977. 9p. (In German).

An electromagnetic actuator is described that permits lifting to great heights with high actuating frequency and high lifting accuracy. It is operable at temperatures near absolute zero and in high vacuum. The actuator has as lift generators expansion or bending bodies to be electrically controlled, favorably made of a piezoelectric or magetostrictive material, with a subsequently added displacement transformer for lift magnification.

55602 Finite element method for a non-linear buckling calculation of shell supports. Harbord, R.; Kroeplin, B. (Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Statik). *Stahlbau;* **46**: No. 10, 314-320(1977). (In German).

The geometrically nonlinear theory of finite displacements is formulated for finite elements in mixed representation. The problem is linearized according to the linear increment method. The method is specialized for thin shell supports and applied in the investigation of the pre- and post-buckling behaviour of plates and cylindrical shell structures. The effects of different boundary conditions and imperfections on the buckling behaviour is illustrated by a few numerical examples.

55603 Definition and numerical evaluation of important reliability characteristics. Dreger, W. (Technische Univ. Berlin (Germany, F.R.); Fachhochschule fuer Wirtschaft, Berlin (Germany, F.R.)). *Maschinenmarkt;* **83**: No. 78, 1546-1550(1977). (In German).

When engineering complex plants questions relating to reliability and availability should be included in the contract between customer and supplier in order to increase the technical performance of such plants. Advice on carrying out a reliability is given and some essential reliability characteristics such long-term availability, medium-term active repair time, medium-term failure intervals, and failure rate and probability of survival are discussed. Furthermore, the scope of simulations concerning the numerical evaluation of reliability characteristics is given with regard to their time dependence.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 54962, 55790, 56285

55604 (AD-A—049117) **A versatile superconducting magnetometer/gradiometer system. Final report.** Nisenoff, M.; Wolf, S.A. (Naval Research Lab., Washington, DC (USA)). Oct 1977. 26p. (NRL-MR—3618). NTIS PC A03/MF A01.

A versatile superconductive magnetometer/gradiometer system was designed and procured from a commercial vendor. A number of magnetic field sensing (pick-up) loops are mounted on a common substrate block and connected through a switching network to a single SQUID sensor. By suitably connecting these coils, it is possible to measure a component of the magnetic field of interest with an instrument noise level of 1.1 x 10(-14) tesla rms per root hertz or at a reduced sensitivity range with an instrument noise level of 1.3 x10(-13) tesla rms per root hertz. In addition, several of the coils can be connected in opposition to measure the diagonal component of the gradient (dH sub i/dX sub i) of the field of interest with an instrument noise level of 1.2 x 10(-15) tesla rms per cm per root hertz. The dewar and probe assembly can be tilted in order to monitor either the horizontal or the vertical field component or (diagonal) gradient component of the field of interest.

55605 (EPRI-EL—479) **Theory and design of a brushless superconducting alternator. Final report.** Mawardi, O.K.; Muelder, S.A. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Electrical Engineering and Applied Physics). Jun 1978. 69p. Dep. NTIS, PC A04/MF A01.

The object of this project was to demonstrate the feasibility of constructing and operating a brushless superconducting generator. In this machine a flux pump would indirectly couple electrical energy into a superconducting rotor, and both the current leads and brushes or slip rings could be eliminated. The demonstration unit was to be rated 1-kVA with an open-circuit voltage of 50 kV. None of the desired machine parameters were obtained because numerous technical difficulties prevented the machine from being successfully run. Nevertheless, a theoretical design for a suitable flux pump was worked out and is presented here.

55606 Superconductor. Juengst, K.P.; Ries, G. (to Gesellschaft fuer Kernforschung mbH). US Patent 4,093,817. 6 Jun 1978. Priority date 23 Apr 1975, German, Federal Republic of (F.R. Germany). 4p.

A superconductor having a plurality of superconducting filaments embedded in a solid conductor of normal conducting material is described. Each of the filaments are twisted about the longitudinal axis of the superconductor to form a helix which is concentric with respect to the longitudinal axis, in order to suppress coupling effects occurring between filaments on circles with different radii in time variable magnetic fields. Each of the filaments is twisted about the conductor axis to provide alternating equal length sections along the conductor axis with opposite senses of rotation of the filaments about the conductor.

55607 Properties of Josephson thin film variable-thickness microbridges. Gubankov, V.N.; Koshelets, V.P.; Ovsyannikov, G.A. (Institute of Radio Engineering and Electronics, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 755-760(Oct 1977).

The properties of submicron variable-thickness Josephson junctions are investigated experimentally in a direct current and in a UHF field. In a certain temperature range, the volt-ampere characteristics of the junctions possess at the beginning of the resistive region a characteristic section with a small differential resistance, which increases with decrease in temperature. The shape and evolution of the volt-ampere characteristics are in accord with the theoretical predictions of Aslamazov and Larkin [Sov. Phys. JETP 43, 698 (1976)]. The theory takes into account the presence of nonequilibrium electrons in the weak coupling region and also the stimulation of superconductivity by a direct current, which is a consequence of this presence. Some features of gap-like volt-ampere characteristics are investigated.

55608 Three-dimensional analytical calculation of magnetic fields and eddy currents in the rotor of a turbogenerator with superconducting field winding. Markus, H. v.; Sergl, J. (Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Energietechnik). *Arch. Elektrotech. (Berlin);* **59**: No. 6, 329-336(1977). (In German).

Explained in the introduction are the problems and the facilitating assumptions on which the presented theory is based. This is followed by a brief survey of the required equations of the magnetic scalar potential, the magnetic vector potential and a special vector potential. Beginning with a double Fourier analysis of the inverse fundamental stator current density the magnetic fields, the eddy currents and the eddy current losses are calculated in three dimensions. Because the thickness of the outer screen is assumed as much larger than the depth of penetration the rotor can be considered as a solid cylinder.

55609 Three-dimensional analytical calculation of the stator field of a turbo-alternator with superconducting field coil. Echtler, K.W. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Elektrische Maschinen und Geraete). *Arch. Elektrotech. (Berlin);* No. 59, 87-105(1977). (In German).

The magnetic field of the stator winding was calculated during steady-state operation in its three dimensions taking into account the exact configuration of the winding (width of the conductors, radius of stator conductors, top/bottom layer, end windings). Magnetic and electric shields of the machine are cosidered in the form of ideal boundarys.

55610 Digital simulation of transients in a turbo-alternator with superconducting field winding. Fuersich, H. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Elektrische Maschinen und Geraete). *Arch. Elektrotech. (Berlin);* No. 59, 153-161(1977). (In German).

For a simplified mathematical model of a turbo-alternator with a super-conducting field winding the fundamental wave of the magnetic field was calculated two-dimensionally with no restrictions concerning the time-dependence of the currents. In the beginning, the solid rotor parts and the shields between field and stator winding are replaced by symmetrical squirrelcages. If the magnetic flux linkages and the electromagnetically generated torques are analyzed, a set of nonlinear differential equations results describing the behaviour of the alternator. By the use of a digital simulation programme it is integrated for transients.

55611 Application of superconducting magnets to high speed trains. Howell, J.P.; Rhodes, R.G. (Univ. of Warwick, Eng.). *Indian East. Eng.;* No. 119, 67-69(1977).

Electrodynamic systems for the magnetic levitation of high speed trains, and international research programs on the use of superconducting magnets in such systems are discussed. (LCL)

PROTECTIVE STRUCTURES AND EQUIPMENT

REFER ALSO TO CITATION(S) 55087

55612 (LA—7317-PR) **Respirator studies for the National Institute for Occupational Safety and Health. Progress report, January 1—December 31, 1977.** Douglas, D.D.; Lowry, P.L.; Richards, C.P.; Geoffrion, L.A.; Yasuda, S.K.; Wheat, L.D.; Bustos, J.M. (Los

Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 46p. (NIOSH—78-161). Dep. NTIS, PC A03/MF A01.

Respirator studies carried out during 1977 for the National Institute for Occupational Safety and Health were directed at the development of respirator testing equipment and methods to improve the means for evaluating the performance of respiratory protective equipment. Major efforts included completion of a study comparing respirator quantitative fit-test results as obtained with a liquid aerosol, a solid aerosol, and a gas test agent; completion of a study designed to determine the feasibility of constructing equivalent high-efficiency particulate filters to replace sorbent canisters for quantitative fit test using aerosol test agents; development of quantitative fit-test procedures for powered air-purifying respirators; development of particulate filter service life test methods using NaCl aerosol; and completion of an interlaboratory comparison of NaCl aerosol penetration through mechanical dust, fume, and mist respirator filters.

55613 (LA-UR—78-1880) **Air cleaning systems analysis and HEPA filter response to simulated tornado loadings.** Gregory, W.S.; Andrae, R.W.; Duerre, K.H.; Horak, H.L.; Smith, P.R.; Ricketts, C.I.; Gill, W. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 13p. (CONF-780819—10). Dep. NTIS, PC A02/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

A computer code, TVENT, for predicting tornado-induced depressurization in air cleaning systems is described. TVENT easily fits on many computers with input/output formats that are familiar to most analysts and HVAC designers. Applications of TVENT to several nuclear facilities in Idaho, New York, and New Mexico are described. Flow-resistance data of HEPA filters for use in TVENT are also described. At low flow resistance appears to be mainly caused by a diffusion mechanism, while at high flow the resistance seems to be caused by the mechanism of momentum exchange.

55614 (LA-UR—78-1890) **Measurements with self-identifying aerosols.** Kyle, T.; Schuster, B.G. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 9p. (CONF-780819—9). Dep. NTIS, PC A02/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

The use of modern single particle detection of aerosols has made it possible to test multiple HEPA filter systems. Problems have been encountered in such tests with the background aerosol on the downstream side of the filters. Since the ducts are maintained at a negative pressure, ambient aerosols leak into the ducts and provide concentrations of particles which are comparable to the number of particles of the test aerosol passing through the filters. The background count creates an upper limit to the protection factor which can be measured. This limitation can be overcome by the use of an identifiable aerosol. The most direct method of identifying an aerosol is to use fluorescent particles, which has been done in the past. In the present case, the fluorescence of the individual particle is used, rather than dissolving the particles in solution to develop the fluorescence. Two systems based upon fluorescent solid or liquid particles are being developed. Both involve single particle detection and excitation by a portable helium-cadmium laser. The advantage of the solid particles system is the ability to capture the particles on a filter. The filter can then be dissolved and the number of particles counted and sized, since the particles do not dissolve. This also permits the use of greater sample flow rates than is possible with a real time system.

55615 (LA-UR—78-1912) **In situ testing of tandem HEPA filter installations with a laser single particle spectrometer system.** Schuster, B.G.; Osetek, D.J. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 10p. (CONF-780819—7). Dep. NTIS, PC A02/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

System components and methodology for in place testing of tandem HEPA filters are described. The system consists of a very high volume thermal DOP generator for producing sufficient challenge aerosol, a single particle intra-cavity laser particle spectrometer for high sensitivity detection, a forward light scattering photometer to measure challenge aerosol concentration, and a diluter to interface the spectrometer and photometer measurements. Results of the measurements on 11 tandem HEPA installations are presented along with problem areas and recommendations for future work.

55616 (LA-UR—78-1913) **Methyl iodide retention on charcoal sorbents at parts-per-million concentrations.** Wood, G.O.; Vogt, G.J.; Kasunic, C.A. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 16p. (CONF-780819—8). Dep. NTIS, PC A02/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

Breakthrough curves for charcoal beds challenged by air containing parts-per-million methyl iodide (^{127}I) vapor concentrations were obtained and analyzed. A goal of this research is to determine if sorbent tests at relatively high vapor concentrations give data that can be extrapolated many orders of magnitude to the region of interest for radioiodine retention and removal. Another objective is to identify and characterize parameters that are critical to the performance of a charcoal bed in a respirator cartridge application. Towards these ends, a sorbent test system was built that allows experimental variations of the parameters of challenge vapor concentration, volumetric flow rate, bed depth, bed diameter, and relative humidity. Methyl iodide breakthrough was measured at a limit of 0.002 ppM using a gas chromatograph equipped with a linearized electron capture detector. Several models that have been proposed to describe breakthrough curves were tested against experimental data. A variety of charcoals used or proposed for use in radioiodine air filtration systems have been tested against 25.7 ppM methyl iodide to obtain these parameters and protection (decomtamination) factors. Effects of challenge concentration, relative humidity, and bed diameter were also investigated. Significant challenge concentration dependence was measured (more efficiency at lower concentration) for two types of charcoals. Increased relative humidity greatly decreased breakthrough times for a given protection factor. Increased bed diameter greatly increased breakthrough times for a given protection factor. Implications of these effects for a test method are discussed.

55617 **Absorption filter.** Neumann, G.M.; Sinhuber, D. (to Delbag-Luftfilter GmbH). US Patent 4,095,965. 20 Jun 1978. Priority date 27 Aug 1975, German, Federal Republic of (F.R. Germany). 6p.

An absorption filter for the purification of gas or air streams, especially gas or air streams which contain toxic or radioactive contaminants is described.

55618 **System to remove particles from a gas.** Clark, R.C. (to Brunswick Corp., Skokie, Ill. (USA)). German(FRG) Patent 2,717,329/A/. 10 Nov 1977. 47p. (In German).

A method is described to remove particles from a fast flowing gas in which deep-bed filter elements are used (fiber mats in which particles are deposited). It works well with flow rates between 50.8 cm/s and 76.2 cm/s even at temperatures over 260°C and in corrosive surroundings. The filter is cleaned by passing a gas flow in reverse direction whilse simultaneously vibrating the filter. The temperature- and corrosion-resistant fiber mass preferably has a graded packing density. The equipment described in detail is relatively small and is suitable for small, compact filtration units.

55619 **Trends and prospect for hot laboratories and post irradiation work.** Cesarano, C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). *Nukleonika;* 22: No. 8, 681-688(1977).

The hot laboratories and related post irradiation techniques, have played an important role in the development of fuel elements. A great increase in the number of commercial power reactors is anticipated, while research and development programs on new reactors and new fuels are still being carried out. As far as the hot laboratories are concerned it appears very likely that they will still play their role as support facilities for the analysis of the in-pile performance of fuel elements. However, since a need of post irradiation work even on a very small extent will problably arise for power station fuels in the next 15 years, this will imply the construction of suitable facilities on site and new hot laboratories in addition to the existing ones.

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 54724

55620 (CONF-780506—37) **Shipping cask criticality analysis utilizing combinatorial geometry with KENO-IV.** West, J.T.; Petrie, L.M. (Union Carbide Corp., Oak Ridge, TN (USA). Computer Sciences Div.). 1978. Contract W-7405-ENG-26. 9p. Dep. NTIS, PC A02/MF A01.

From 5. symposium on packaging and transportation of radioactive materials; Las Vegas, NV, USA (7 May 1978).

KENO-IV/CG represents an important step forward in geometric modeling capability for criticality analysis. With the merging of KENO geometry's repeating cell feature and combinatorial geometry's detailed modeling ability and simplified input specifications, many geometric approximations required for previous criticality calculations are no longer necessary. Also, many of the features in KENO-IV/CG lend themselves to further development. Therefore, it represents a step forward in the state-of-the-art for Monte Carlo criticality analysis. All of the problems analyzed with KENO-IV/CG at ORNL have agreed well with experimental data where results are available. KENO-IV/CG provides industry with a very powerful tool for accurately modeling very complex geometries.

55621 Monte Carlo analysis of highly compressed fissile assemblies. Pt. 1. Bare spheres. Raspet, R.; Baird, G.E. (Mississippi Univ., University (USA). Dept. of Physics and Astronomy). *Atomkernenergie;* **31**: No. 3, 200-202(1978).

Laser induced fission of highly compressed bare fissionable spheres was analyzed using Monte Carlo techniques. The critical mass and critical radius as a function of density are calculated and the fission energy yield is calculated and compared with the input laser energy necessary to achieve compression to criticality.

SHIPPING CONTAINERS

REFER ALSO TO CITATION(S) 54692

55622 (BNWL-SA—6093) **Estimating particle release through gas leaks in dry powder shipping containers.** Schwendiman, L.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1977. Contract EY-76-C-06-1830. 31p. (CONF-770720—13). Dep. NTIS, PC A03/MF A01.

From 22. annual meeting of the Health Physics Society; Atlanta, GA, USA (3 Jul 1977).

Information is presented from which an estimate can be made of the release of plutonium oxide from shipping containers. The leak diameter is estimated from gas leak tests of the container and an estimate is made of gas leak rate as a function of pressure over the time of interest in the accident. These calculations are limited in accuracy because of assumptions regarding leak geometry and the basic formulations of hydrodynamic flow for the assumed conditions. Sonic flow is assumed to be the limiting gas flow rate. Particles leaking from the air space above the powder will be limited by the low availability of particles due to rapid settling, the very limited driving force (pressure buildup) during the first minute, and the deposition in the leak channel. Equations are given to estimate deposition losses. Leaks of particles occurring below the level of the bulk powder will be limited by mechanical interference when leaks are of dimension smaller than particle sizes present. Some limiting cases can be calculated. When the leak dimension is large compared to the particle sizes present, maximum particle releases can be estimated, but will be very conservative. Further theoretical and experimental studies are needed to better define the hydrodynamics of gas flow in leaks of the size being considered, and to establish particle transport rates through known geometry leak paths.

55623 (NUREG—0360) **Qualification criteria to certify a package for air transport of plutonium.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Dec 1977. 63p. NTIS $5.25.

The document describes qualification criteria developed by the U.S. Nuclear Regulatory Commission to certify a package for air transport of plutonium. Included in the document is a discussion of aircraft accident conditions and a summary of the technical basis for the qualification criteria. The criteria require prototype packages to be subjected to various individual and sequential tests that simulate the conditions produced in severe aircraft accidents. Specific post-test acceptance standards are prescribed for each of the three safety functions of a package. The qualification criteria also prescribe certain operational controls to be exercised during transport.

55624 (NUREG—0361) **Plutonium air transportable package Model PAT-1. Safety analysis report.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Feb 1978. 221p. NTIS $9.25.

The document is a Safety Analysis Report for the Plutonium Air Transportable Package, Model PAT-1, which was developed by Sandia Laboratories under contract to the Nuclear Regulatory Commission (NRC). The document describes the engineering tests and evaluations that the NRC staff used as a basis to determine that the package design meets the requirements specified in the NRC "Qualification Criteria to Certify a Package for Air Transport of Plutonium" (NUREG-0360). By virtue of its ability to meet the NRC Qualification Criteria, the package design is capable of safely withstanding severe aircraft accidents. The document also includes engineering drawings and specifications for the package. 92 figs, 29 tables.

TRANSPORT AND STORAGE FACILITIES

REFER ALSO TO CITATION(S) 55753

MINING AND DRILLING EQUIPMENT AND FACILITIES

55625 (SAND—78-0677C) **Development of a diffusion bonding technique for attaching Stratapax cutters to drill bits.** Huff, C.F.; Varnado, S.G. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 8p. (CONF-780825—8). Dep. NTIS, MF A01.

From 4. symposium on enhanced oil and gas recovery and improved drilling methods; Tulsa, OK, USA (29 Aug 1978).

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Sandia Laboratories is developing an improved technique for attaching the General Electric man-made diamond cutter, Stratapax, to drill bits. Recent progress made on the development of the diffusion bonding technique is described. Efforts include utilization of commercial suppliers to metallize and bond the Stratapax to stud or bit, various refinements to the bonding process, design of bits to be used in laboratory, and field testing of the bonds. The metallization and bonding procedures developed at Sandia Laboratories have been transferred to commercial suppliers, and these suppliers have been used to provide sample parts. The bond strengths obtained from the commercial sources approach the values obtained in the laboratory at Sandia (65,000 psi minimum shear strength). All suppliers were able to successfully metallize the first attempt, although some process control problems have become apparent on subsequent experiments. The process should be fully available for commercial utilization by the end of 1978, although production capacity will be limited. Additional experiments were conducted in an attempt to improve manufacturability and reliability. Results of investigations of pressure transfer materials and canning procedures are described. The test bits being fabricated include a $4^3/_4$ inch all-Stratapax bit, a $7^7/_8$ inch hybrid roller cone Stratapax bit, and an NQ core bit. The $4^3/_4$ inch bit has been fabricated by Sandia and tested at the Drilling Research Laboratory. The hybrid bit is being designed and fabricated in a cooperative program with Smith Tool Company and the NQ bit with American Coldset Corporation. Results of recent laboratory drilling tests with the $4^3/_4$ inch bit are described.

55626 Torsional oscillations of winding engines fed by thyristors during stopping. Altenbernd, G.; Wiemers, H. *Glueckauf-Forschungsh.;* **39**: No. 3, 93-97(Jun 1978). (In German).

During stopping, the conveyors 'hard switching' thyristor circuits, great torsional oscillations may occur, which could not previously be observed by conventional technological means. As the safety of such plants must not lag behind that of conventional technology, from the design stage onward, suitable measures regarding circuitry must be taken to suppress the torsional oscillations, whose possible effects are given. The physical effect of these circuitry measures are discussed.

55627 Chamber's research programme: latest development work evaluated. *Coal, Gold Base Miner. South. Afr.;* **26**: No. 5, 59, 61, 63, 65, 69, 169(May 1978).

Experimental work that has been carried out towards improving underground thermal environment in deep mines is described. It had previously been recognized that high rock temperatures and autocompression of downcast air invariably meant a wet bulb temperature exceeding 27°C or 28°C for ventilation air reaching stopes at depths below sea level--a temperature at which acclimatization of miners becomes essential. Refrigeration becomes necessary to cool the incoming air and, experience has shown, distribution of refrigeration to the distant work places is perhaps the most troublesome and expensive of all operations involved in the cooling of mines. Research Services, which has already achieved great progress in the area of heat acclimatization, has made further advances. Attention has been focused mainly on the reduction of the number of unproductive shifts while still maintaining a high standard of safety to the individual. The introduction of ascorbic acid (vitamin C) supplementation has changed previous concepts and has opened up new avenues of investigation. Consequently, a series of heat tolerance tests has been developed for various underground environments. This approach holds great promise for decreasing the number of acclimatization shifts. Evidence has also been obtained that hyper-heat-tolerant men (oral temperature 37.5°C or less during the heat tolerance test) can be posted directly underground without any need for further acclimatization. Ascorbic acid remains an essential part of these procedures.

LASERS

REFER ALSO TO CITATION(S) 56300

55628 (AD-A—049028) **O2(1 delta)-i atom energy transfer studies: cw inversion on 1.315-micrometer i-atom transition. Interim report.** Heidner, R.F. III; Coffer, J.G.; Gardner, C.E. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 15 Dec 1977. Contract F04701-77-C-0078. 87p. NTIS PC A05/MF A01.

Low-temperature ozone photolysis (LTOP) has been developed as a cw source of O_2(a 1Delta g). This method yielded large O_2(1 Delta)/O_2(3 Sigma) ratios in a chemically clean system. Iodine was injected into a flowing stream of the LTOP products, and the fast energy-transfer process between O_2(1 Delta) and I(2P(3/2) created a population inversion,(I(2P(1/2))/(I(2P(3/2))) > or = 0.5, on

the I-atom laser transition at 1.315 micrometers. The development of quantitative diagnostic techniques for the O_2-I_2 system and their application to both electrical discharge and LTOP generation of O_2(a 1Delta g) are described in this report. Emphasis is on the scaling required to produce a cw I-atom laser based on this latter experimental method.

55629 (AD-A—049116) **The NRL one kilojoule CO_2 laser. Interim report.** Pechacek, R.E.; Greig, J.R.; Raleigh, M.; Rod, S.R. (Naval Research Lab., Washington, DC (USA)). Sep 1977. 33p. (NRL-MR—3602). NTIS PC A03/MF A01.

This report describes an ultraviolet preionized, CO_2 laser head developed at NRL for use in plasma production experiments. A 1000 Joule CO_2 laser, consisting of four of these heads is to be used with a 100 J ND-glass laser to produce a large, moderately warm plasma (N = 3 x 10 to the 19th power ions, T approx 50 eV), which is to be studied in a variety of magnetic field geometries. The 3.5 liter TEA CO_2 laser when connected as an oscillator followed by three amplifiers, produces one Kilojoule pulses of 10.6 micrometer radiation. The pulses consist of 70 Nsec, FWHM, initial spike followed by a 1.0 microsecond tail. The spike contains 30% of the laser pulse energy and it attains a peak power of 4.3 GW corresponding to a gas mixture of 1:1:8 (CO_2:N:He). The firing rate is every 6.5 minutes. The area of the beam is 300 sq cm. the divergence of the laser beam is about 1.2 mrad, about 20 times larger than the diffraction limit.

55630 (AD-A—049929) **Simultaneous frequency stabilization and injection in a TEA-CO_2 oscillator.** Lachambre, J.-L.; Otis, G.; Lavigne, P. (Defence Research Establishment Valcartier, Courcelette, Quebec (Canada)). Jan 1978. 14p. (DREV-R—4088/78). NTIS PC A02/MF A01.

A novel technique that uses a single master oscillator to serve both the injection and the stabilization function in a TEA-CO_2 laser transmitter is described. The method, based on a two polarization scheme, provides sufficient optical isolation between the TEA laser pulse and the probing laser beam to prevent any damage or saturation of the controlling system. Reproducible and stable SLM operation in the MW power levels are achieved on a long-term basis.

55631 (AD-A—050075) **Energy storage and two-photon extraction from metastable states. Final report 19 Apr 74—30 Jun 77.** Komine, H. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Nov 1977. Contract F44620-74-C-0039. 165p. (GL—2753). NTIS PC A08/MF A01.

This dissertation presents experimental studies on the energy storage characteristics of excited metastable species and theoretical analysis of optical energy extraction schemes based on stimulated two-photon transitions. The large energy capacity and long lifetime of metastable states offer attractive properties for generating high energy optical pulses for laser fusion and photochemical studies. Recent experimental results on the metastable states of molecular mercury illustrate some of the important properties of energy storage in a gaseous medium. In particular, collisional deactivation of excited metastable species by mutual two-body quenching and by molecular formation are discussed in relation to storage limitations. The optical extraction of energy stored in an inverted metastable system using stimulated two-photon transitions offers nonlinear characteristics not available in the ordinary laser amplifiers. Analytical expressions for the extraction efficiency of an ideal two-photon emission amplifier are derived. The experimental requirements for the proposed systems based on the calculated gains indicate that the currently available pumping methods and trigger laser sources may lead to a demonstration of two-photon amplification and energy extraction.

55632 (AD-A—050443) **Study of surface finishing and coating of DF laser windows. Annual technical report 1 Apr 76—31 May 77.** Harrington, J.A.; Braunstein, M.; Garcia, B.; Rudisill, J.E. (Hughes Research Labs., Malibu, CA (USA)). Jul 1977. Contract N00014-75-C-0891. 42p. NTIS PC A03/MF A01.

Research was conducted into the minimization of optical absorption in low-loss window and coating materials for use in high-power DF chemical lasers. Candidate coating materials that were investigated as single-layer, half-wave thick films at 3.8 micrometers include PbF_2, ThF_4, ZnSe, Si, MgO, $Al2O_3$, LiF, and NaF on CaF_2 substrates. Of these, the fluorides have the lowest absorption losses and the Si and oxide films have the largest. A thorough study of extrinsic absorptions in ThF_4 and ZnSe films on CaF_2 was performed in conjunction with NRL using attenuated total reflection spectroscopy. ZnSe films showed considerably less OH(-) absorption than did the ThF_4 films.

55633 (AD-A—050469) **Experimental performance of a 15 kilowatt cw CO_2 electric discharge laser. Final report Jan 76—Jul 77.** Rabe, D.C. (Air Force Aero-Propulsion Lab., Wright-Patterson AFB, OH (USA)). Nov 1977. 30p. (AFAPL-TR—77-74). NTIS PC A03/MF A01.

The fabrication and initial experimental checkout of an Electric Discharge Laser (EDL) System is described. This continuous wave carbon dioxide laser extracts power in excess of 12 kilowatts routinely at an electrical discharge efficiency of 27% and a mass flow efficiency in excess of 100 Kw/lbm/sec. With the current resonator optics, the output intensity distribution is circular, uniform and repeatable to within 5%. This laser has performed over 8,000 experiments ranging from 1 to 10 seconds in duration.

55634 (AD-A—050471) **Excimer potential curves. Annual report No. 1, 1 Oct 76—31 Dec 77.** Taylor, H.S.; Valley, M.; Watts, C.; Bobrowicz, F. (University of Southern California, Los Angeles (USA)). 1 Feb 1978. Contract N00014-77-C-0102. 69p. NTIS PC A04/MF A01.

The present status of an effort to develop and implement semi-empirical and theoretical methods for obtaining potential curves of diatomic excimer systems is discussed. A configuration interaction calculation on GaKr is presented along with preliminary results of a Gordon-Kim calculation. The basic theory of the semi-empirical electron scattering model is also given.

55635 (AD-A—050480) **Optical-microwave interactions in semiconductor devices. Quarterly report No. 1, 17 Jun—14 Sep 77.** Yen, H.; Barnoski, M. (Hughes Research Labs., Malibu, CA (USA)). Oct 1977. Contract N00173-77-C-0156. 39p. NTIS PC A03/MF A01.

Theoretical and experimental studies of direct current modulation of semiconductor injection lasers were carried out. In the small signal approximation it was found that the maximum usable frequency of modulation was limited to under 10 GHz. Experimentally the modulation of a single mode laser up to 3.4 GHz which was currently limited by the detection system was demonstrated. Optical injection locking experiments were carried out at low frequencies (2GHz). Injection locking was observed not only at fundamental frequencies but also at various subharmonics with less tolerance in frequency deviation. It is also possible to achieve simultaneous switching and phase locking in these oscillators.

55636 (AD-A—050579) **Novel chemical laser systems. Final report 15 Jun 74-31 Mar 77.** Cool, T.A. (Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics). Nov 1977. 40p. NTIS PC A03/MF A01.

Chemiluminescence spectra were recorded for a variety of metal-oxidizer reactions. Measurements of fluorescence rates were performed for molecular bonds and atomic emissions. Dissociation reactions to produce large concentrations of metal atoms on a short time scale were carried out by means of thermal, electrical and electron beam methods. Nearly all systems studied had low fluorescence rates for product metal oxide or metal halide molecules. Laser action was observed for over 40 new wavelengths from 17 metal atoms formed from the dissociation of metal halides, hydrides, alkyls and carbonyls. These wavelengths were in the near IR from 1.152 to 14.54 micrometers and were identified with transitions in the atoms: As, Bi, Cd, Fe, Ga, Ge, Hg, In, Ni, Pb, Se, Sn, Te, Tl, V and Zn. Electronically excited YCl was formed from the reaction of chlorine with Y metal; chemiluminescent spectra from the excited YCl species were recorded in a shock tube-driven supersonic mixing flame. Strong emission was noted near 4000Z and weaker bands at longer wavelengths believed to arise from triplet states of chemically formed YCl. This reaction system is of interest because of a high photon yield, a high degree of specificity in energy disposal among product states and the possible existence of laser transitions of appropriate radiative lifetimes for chemical laser operation.

55637 (AD-A—050591) **Excimer laser research. Semiannual report 16 Mar-15 Sep 77.** Parks, J.H. (Avco-Everett Research Lab., Everett, MA (USA)). 1977. Contract N00014-75-C-0063. 27p. NTIS PC A03/MF A01.

Experimental and theoretical investigations of the mercury monohalides are described. As a class, these molecules show great promise for achieving high power scalable laser action in the visible portion of the spectrum.

55638 (COO—4223-3) **Investigation of concept of efficient short wavelength laser. Quarterly progress report, 1 October 1977—31 January 1978.** (Physical Sciences, Inc., Woburn, MA (USA)). 1 Mar 1978. Contract ES-77-C-02-4223. 21p. (PSI-TR—120). Dep. NTIS, PC A02/MF A01.

The experimental apparatus which was designed to study the wavelength-selected photolysis of gaseous azides has been completely assembled, and much component testing and calibration has been done. Numerous problems with the photolysis laser have precluded full experimental operation. Nevertheless, a few preliminary experiments on the photolysis of HN_3 have been done and NH(a ^{1}DELTA) has been positively identified as a major product. The sensitivity of the laser-induced fluorescence detection system has been tested in a few experiments on OH which was produced by chemical methods.

55639 (COO—4252-2) **Investigation of topics related to multi-line operation of a gas laser. Final report, April 1, 1977—March 31, 1978.** Javan, A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). 31 Mar 1978. Contract ES-77-S-02-4252. 4p. Dep. NTIS, PC A02/MF A01.

The research performed under this contract concerned the investigation of the possibility of operating a gas laser simultaneously on several preselected transitions. A new resonator design was used to obtain multi-transition operation utilizing a process similar to the injection locking. The process was studied theoretically and experimentally. The investigation provided detailed information in connection with multi-line energy extraction from a high energy TEA-type CO_2 oscillator.

55640 (LA—7329-T) **Comprehensive study of excimer laser systems.** Butcher, R.R. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 107p. Dep. NTIS, PC A06/MF A01.

Thesis.

Rare gas halogen lasers are finding increasing usage as an intense source of ultraviolet energy. Many applications require a high energy laser capable of operation at reasonably high repetition rates. Electrical discharge pumping satisfies these requirements quite nicely, however, to date little has been reported on the discharge characteristics of this class of laser. A parametric study done on electrical discharge excimer laser systems is described. A flashboard pre-ionized excimer laser utilizing a cable pulse forming network (PFN) for the main discharge was designed and tested. Extensive voltage and current data were taken with various gas mixtures at various pressures. The voltage and current data were digitized and used to find such parameters as dynamic impedance of the load, energy deposited in the gas, and peak power during the pulse. The effects of varying the length and impedance of the cable PFN were studied. Several interesting relationships were discovered between the various parameters. A computer simulation was used to verify the consistency of the data. A comparison of the computer simulated voltage and current pulse to the measured data indicates the data is internally consistent. Two experiments are described using the lasers studied. The threshold for laser induced air breakdown was measured at 193 nm and at 248 nm. A series of Raman scattering experiments was conducted to obtain levels of energy and wavelengths which were beyond the reach of other experimenters. The high power and beam quality achieved with these lasers was adequate for the purposes of the experiments. Conclusions are presented relating to the scaling factors for excimer laser systems.

55641 (UCRL—13871) **Preparation and properties of fluoride glasses. Final report, May 1, 1975—April 30, 1978.** Mackenzie, J.D. (California Univ., Los Angeles (USA). Dept. of Materials). May 1978. Contract W-7405-ENG-48. 62p. Dep. NTIS, PC A04/MF A01.

Research into the production of fluorberyllate laser glass has shown that these glasses are of tremendous potential as high power laser materials. Their spectroscopic properties are vastly superior to currently available silicate, phosphate or fluorophosphate glass systems. Fabrication of fluoroberyllate glasses is extremely difficult. Atmospheric and crucible reactions can be quite severe. Best results were obtained using covered vitreous carbon crucibles in a dry, nonreactive atmosphere (e.g., N_2). Atmosphere reactions can have a pronounced effect on the uv cutoff. A distillation device for purification of BeF_2 has been built. Distillation was able to eliminate most of the common impurities, and in particular, "water." Thus for high purity glasses, distillation should be considered. The role of "water" in fluoroberyllate glass systems is not entirely understood, but it should not be underestimated. Its effect on properties such as the electrical resistivity appear to be substantial. Its role on the optical processes involved in laser glasses can be very significant depending on the laser wavelength. It is possible that traces of "water" can alter the refractive index of these glasses as well. (10 figures, 11 tables)

55642 **Experimental and theoretical study of the xenon laser and associated high-gain phenomena.** Sandoval, R.P.; Moreno, J.B. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.;* **49**: No. 10, 5107-5113(Oct 1978).

A pulsed infrared xenon laser system, constructed to study phenomena associated with high gain, is described. Extracted-power measurements from both an amplifier and an oscillator are presented. Comparison with semianalytical solutions of simple-model equations is made to obtain estimates for small-signal gain (2.0 cm^{-1}) and saturation intensity (0.2 W/cm^2). The effects of aperturing and wall reflectivity on oscillator output are also studied. A simple model together with measurements show that aperturing enhances parasitic oscillations.

55643 **Conductively cooled flashlamp.** Hill, L.W.; Cassiero, R.L.; Taylor, P.F.; Tuchyner, H.J. (to Hughes Aircraft Co.). US Patent 4,096,450. 20 Jun 1978. Filed date 22 Apr 1977. 6p.

An improved laser cooling system for high repetition rate lasers is described in which a flashlamp is cooled by conducting the heat generated in the lamp directly to a holder which is a solid thermal conductor formed by the structure of the pump cavity and in turn to a heat sink without using flowing gas or liquid in the cavity or space surrounding the flashlamp. The flashlamp is fixedly mounted on the holder with a gap or space therebetween. A thin layer of barium sulfate powder or any other suitable material (which can physically conform to the outside surface of the flashlamp envelope while providing adequate thermal conductivity between the flashlamp and the holder, and adequate optical reflectivity) is then packed in the gap between the flashlamp envelope and the holder in order to reflect light efficiently and to provide a good thermal contact between the holder and the flashlamp. Using the powder in this fashion tolerates any irregularities in standard flashlamp surfaces and housing surfaces that are caused in their production and so allows use of any suitable flashlamp and housing. This flashlamp cooling system is more compact and cheaper to make than existing systems, and allows easier replacement of the flashlamp.

55644 **Unstable resonator laser system.** Fluhr, F.R. (to Secretary of the Navy). US Patent 4,096,447. 20 Jun 1978. Filed date 24 Nov 1976. 4p.

Optical radiation reflective surfaces are described for use in an unstable resonator laser system in which the output beam of the system does not contain an aperture in the middle of the beam thereby avoiding the requirement of a collimation lens system to obtain a beam of minimum divergence. The system provides an output beam which does not have a central hole.

55645 **Broadband gas laser.** Clark, G.L. (to TRW Inc.). US Patent 4,095,193. 13 Jun 1978. Filed date 22 Jan 1976. 8p.

A gas laser having a bandwidth which substantially exceeds the normal doppler bandwidth is described. To this end the lasing beam is made to propagate at an angle to the direction of flow of the stream of lasing gases. The gases should move at a supersonic speed so that the normal doppler bandwidth of the laser is shifted up or down in frequency by a predetermined amount. By utilizing two or more gas flows at different angles to each other, the normal amplification band of the laser medium can be shifted up and down in frequency by different amounts to obtain an overall bandwidth on the order of 1 to 2 GHz.

55646 **High reflectivity laser mirrors.** Mills, G.J. (to Northrop Corp.). US Patent 4,093,349. 6 Jun 1978. Filed date 27 Oct 1976. 6p.

A mirror for high power lasers comprising a high reflectivity superlattice surface formed of a copper-gold alloy on a copper base, and the method of making the same are described.

55647 **Pulsed gas laser.** Levine, J.S. (to Massachusetts Inst. of Tech.). US Patent 4,093,927. 6 Jun 1978. Filed date 21 Jan 1976. 6p.

A pulsed gas laser is described in which a multitude of sheet-form conductors are assembled face to face with aligned apertures defining a beam path through the thickness of the assembly. In the embodiment shown the conductors are paired to form transmission lines, one conductor of each transmission line being interrupted and exposed at the aperture to form a discharge gap while the opposite conductor is electrically isolated from the aperture. The impedance introduced to the transmission line discharge circuit by a suitable aperture is found to be sufficiently low to permit application of a fast rise voltage wave for energizing gas at the gap. Increase in the number of elements in the assembly can progressively increase performance over a wide range.

55648 **Device for applying a laser pulse delivered by a laser oscillator.** Farcy, J.C. (to Commissariat a l'Energie Atomique). US Patent 4,093,924. 6 Jun 1978. Priority date 23 Dec 1974, France. 10p.

A light-amplifying medium is pumped by an auxiliary excitation source and has a number of energy levels, the laser transition being intended to correspond to the laser pulse delivered by the oscillator and to take place between the upper laser level and the lower laser level. Mirrors placed around the amplifying medium reflect the laser pulse from one mirror to the next so that the time interval between two successive pulse traversals within the amplifying medium is longer than the time of population transfer between on the one hand the upper reserve level and the upper laser level and on the other hand the lower laser level and the lower reserve level. The amplifying medium is thus regenerated by population exchange at the lower and upper levels between each pulse traversal through the amplifying medium.

55649 **Design and fabrication of a high energy pulse CO_2 laser.** Huang, K.C.; Hsu, L.S. (National Chiao Tung Univ., Hsinchu, Taiwan). *Proc. Natl. Sci. Counc., Repub. China;* **2**: No. 2, 177-183(1 Apr 1978).

A new technique has been developed for making the excitation of the longitudinal-excited carbon dioxide lasers more efficient. The technique was named the Double-Pulse-Discharge Technique.

The experimentation shows that the technique doubles both the efficiency and laser output energy given by the conventional schemes. The quantitative discussion on the laser output characteristics of the effect of working parameters such as gas pressure, excitation voltage, energy storage capacitor, preionization capacitor and repetition rate is presented. The research results have now formed the basic framework for making a laser drill.

55650 Amplitude-spectral asymmetry of stimulated emission from dye solutions. Bezrodnyi, V.I.; Narovlyanskaya, N.M.; Tikhonov, E.A. (Institute of Physics, Academy of Sciences of the Ukrainian SSR, Kiev). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 169-173(Feb 1978).

A report is given of a study of the amplitude-spectral asymmetry of the stimulated emission of superfluorescence from dye solutions pumped longitudinally by nanosecond laser pulses. This amplitude asymmetry is manifested by the difference between the powers of the forward and backward waves, and it is a function of the rate of pumping and of the optical density of the active medium. The asymmetry of stimulated emission from a ring laser is manifested by the appearance of a wave with a traveling-wave ratio of ~90 in the absence of any optical isolators. The spectral asymmetry of a ring laser is manifested by a difference between the spectra of strong and weak waves traveling in opposite directions. A quantitative analysis is made of the effects based on the solution of the transfer equations for radiation traveling in a nonlinearly absorbing active medium.

55651 Influence of superfluorescence on the operation of lasers with dye amplifiers. Narovlyanskaya, N.M.; Tihkonov, E.A. (Institute of Physics, Academy of Sciences of the Ukrainian SSR, Kiev). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 173-177(Feb 1978).

An investigation was made of a longitudinally pumped laser—single-pass dye amplifier system with a view to optimizing the total conversion efficiency. It was shown that competition between two processes: amplification of the external signal and of the spontaneous noise: determines the total efficiency of conversion of the pump into useful signal. The superfluorescence restricts the maximum gain and conversion efficiency of small external signals, as does the saturation by the signal being amplified in the case of large external signals. A quantitative analysis was made of the choice of optimal optical density of the amplifier and of the competition between two coupled waves in a nonlinearly amplifying medium.

55652 Faraday rotation in the active medium of an iodine photodissociation laser oscillator or amplifier. Kiselev, V.M.; Bobrov, B.D.; Grenishin, A.S.; Kotlikova, T.N. *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 181-184(Feb 1978).

Estimates are reported of the Faraday rotation of the plane of polarization of the stimulated radiation emitted from the active medium of an iodine photodissociation laser oscillator and amplifier, subjected to an axial magnetic field. The results of calculations are confirmed experimentally.

55653 Investigation of a barium vapor laser. Bokhan, P.A.; Solomonov, V.I. (Institute of Atmospheric Optics, Siberian Branch of the Academy of Sciences of the USSR, Tomsk). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 184-187(Feb 1978).

A study was made of the energy characteristics of a barium vapor laser operating at a wavelength of 1.5 μ. A maximum specific energy output of 8 μJ/cm³ was obtained at an efficiency of 0.16%. Under constant excitation conditions the specific energy output was independent of the discharge-tube diameter.

55654 Measurement of the reflectivity of metal mirrors acted on by laser radiation. Bessarab, A.V.; Zhidkov, N.V.; Kormer, S.B.; Pavlov, D.V.; Funtikov, A.I. *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 188-191(Feb 1978).

A study was made of the reflectivity of copper, aluminum, and stainless steel mirrors acted on by neodymium-laser pulses of ~400 nsec duration and ~70 J energy. The temperature and luminosity of the irradiated surface were recorded at the same time. Within an experimental error of +- 10%, the reflection coefficient of the mirrors remained constant right up to the energy density at which intense evaporation of the metal occurred. There was a substantial reduction in the reflection coefficient when an absorbing discharge formed in the vapor. The results obtained were compared with heating calculations using the linear theory of heat conduction and data from other publications.

55655 Mutual quenching of axial modes in two-mode lasers. Lugovoi, V.N. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 198-201(Feb 1978).

An analysis is made of stimulated emission from active two-level particles with a homogeneously broadened transition line in a two-mode axial optical resonator. It is assumed that the particles fill the volume where the spatial structures of the mode fields are similar and that the intermodal beat period exceeds the relaxation time of the populations of the particle energy levels. The range of existence of two different (mutually exclusive) stable single-frequency emission regimes is determined and the hysteresis in the system is discussed. The use of such lasers as optical memory elements and logic devices is proposed.

55656 Investigation of a transversely excited pulsed copper vapor laser. Bokhan, P.A.; Shcheglov, V.B. (Institute of Atmospheric Optics, Siberian Branch of the Academy of Sciences of the USSR, Tomsk). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 219-222(Feb 1978).

The influence of the gas-discharge parameters on the specific laser output energy and efficiency of a transversely excited copper vapor laser was investigated. For a Cu—Ne mixture, two optimum buffer-gas pressures were found. A maximum specific output energy of 55 μJ/cm³ was obtained at an efficiency of 1%. The optimum pulse repetition frequencies for lasing were determined.

55657 Electron-beam-initiated F_2—H_2 chemical laser. Baranov, V.K.; Demidenko, Y.N.; Zelenskii, K.F.; Kormer, S.B.; Pegoev, I.N.; Troshkin, I.A.; Tsukerman, V.A.; Shchetinin, E.N.; Yushko, K.B. *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 238-239(Feb 1978).

Experiments were carried out on an F_2:O_2:SF:H_2=3.6:1.4:1.0:1.0 mixture in which laser action was initiated by a beam of 300—400 keV electrons. The amplitude of the electron current was 15 kA, the duration of the pulses was 30 nsec, and the energy of the beam was 150 J. The dependence of the output energy on the total pressure of the mixture was determined. Laser pulses of 67 J energy, 100 nsec duration, and 5 x 10^{-2} rad divergence were obtained. The electrical efficiency of the laser was 45%.

55658 Stimulated emission in far ultraviolet due to transitions in multiply charged neon-like ions. Vainshtein, L.A.; Vinogradov, A.V.; Safronova, U.I.; Skobelev, I.Y. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 239-242(Feb 1978).

The possibility of stimulated emission as a result of transitions in multiply charged neon-like ions is considered. The energies of excited terms with the $2p^5 3s$, $2p^5 3p$, and $2p^5 3d$ configurations are calculated for ions with Z=4—17. The wavelengths of the expected laser transitions are given for the λ≈250—1600 A range.

55659 Possibility of constructing a chemically pumped laser emitting visible radiation from S_2 molecules. Bashkin, A.S.; Kupriyanov, N.L.; Oraevskii, A.N. (P.N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 242-244(Feb 1978).

An analysis is made of the possibility of constructing a chemical laser emitting visible radiation from S_2 molecules as a result of bimolecular and trimolecular reactions. Estimates of the gain for photolytic and thermal initiation methods demonstrate the possibility of achieving stimulated emission as a result of the $B^3\Sigma^-$/sub u/—$X^3\Sigma^-$/sub g/ transition.

55660 Ultraviolet dye lasers pumped by excimer lasers. Lisitsyn, V.N.; Razhev, A.M.; Chernenko, A. (Institute of Semiconductor Physics, Siberian Branch of the Academy of Sciences of the USSR, Novosibirsk). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 244-245(Feb 1978).

Pulse-periodic KrF and XeBr lasers were used to pump solutions of the following organic scintillators: paraterphenyl, PPO, and 1,4-diphenylbutadiene. Continuously tunable radiation in the 334—380 nm range was obtained.

55661 Coherent properties of a copper vapor laser and dynamic holograms in vanadium dioxide films. Zemskov, K.I.; Kazaryan, M.A.; Mokerov, V.G.; Petrash, G.G.; Petrova, A.G. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* 8: No. 2, 245-247(Feb 1978).

Dynamic holography in vanadium dioxide films was used to study experimentally the coherence of the radiation emitted from a copper vapor laser. It was established that the temporal coherence length exceeded 12 cm and the spatial coherence length was at least equal to the laser beam diameter. An investigation was made of the holographic characteristics of vanadium dioxide using the copper vapor laser to record and reconstruct holograms. The investigation included the dependence of the diffraction efficiency on the power of the laser pulses and their repetition frequency. The possibility of optical modulation of the semiconductor—metal phase transition and of the corresponding recording and erasure of holograms in VO_2 at frequencies above 10 kHz was demonstrated for the first time. There was no deterioration in the holographic characteristics of VO_2 after more than 10^8 recording—erasure cycles.

55662 Excitation of metal vapor lasers by pulse trains. Gordon, E.B.; Egorov, V.G.; Pavlenko, V.S. (Institute of Chemical Physics,

Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 2, 266-268(Feb 1978).

Stimulated emission as a result of transitions in metal atoms was excited by trains of short ($\sim 10^{-7}$ sec) electric current pulses with a variable off-duty factor. This method was applied to a copper chloride vapor laser and it made it possible to maintain a steady temperature (to within +- 5°) in a laser tube for a long time (over 2 h) when the repetition frequency of the excitation pulses in a train was varied from 8 to 50 kHz. Moreover, this method made it possible to use low-power sources in achieving stable stimulated emission from such lasers and to predict the operating conditions in lasers with a moderate output power, as well as to investigate the processes occurring in a laser medium more simply and conveniently than by the two-pulse methods.

55663 Influence of self-focusing on the operation of a neodymium glass laser. Drobnik, A.; Wolf, L. (Institute of Physics at the Polytechnic, Lodz, Poland). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 2, 274-275(Feb 1978).

An acetone-filled cell was placed inside the resonator of a neodymium laser. A slight inclination of the nontransmitting laser mirror made it possible to emit single giant pulses of 0.3 MW power and 50 nsec duration. This was attributed to self-focusing and splitting of the beam into separate filaments.

55664 Deformation of the resonator of a neodymium glass laser due to a change in the polarizability of excited neodymium ions. Bubnov, M.M.; Grudinin, A.B.; Dianov, E.M.; Prokhorov, A.M. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 2, 275-278(Feb 1978).

A description is given of a method for measuring the change in the polarizability of neodymium ions due to their transitions from the ground state ^{4}I/sub 9/2/ to the metastable level ^{4}F/sub 3/2/. The results are reported for seven industrial laser glasses. The change in the polarizability is given as (0.9 +- 0.1) x 10^{-25} cm^3. These measurements are used to calculate the average oscillator strength of various allowed transitions between the 4f and 5d shells of the neodymium ion. It is shown that the formation of a lens in the active element, due to a change in the polarizability of neodymium ions, prevents full compensation of the resonator deformation by a suitable selection of the laser glass.

55665 Formation of fine structure of laser lasing spectrum in the transparency microwindows of gaseous media. Godlevskii, A.P.; Kopytin, Y.D. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **44**: No. 2, 185-187(Feb 1978).

Possible use of the mechanism of selective intracavity absorption for the formation of hyperfine structure of the laser lasing spectrum is studied theoretically and experimentally by introducing into the cavity the type of gas whose effect on the propagation of radiation in the medium needs to be removed. Conditions of total line burning in the lasing spectrum are found taking into account the mutual effect of the group of absorption lines for a laser with an inhomogeneously broadened gain profile. Experimental verification of the method is made at different partial pressures of the absorbing and buffer gas in the cavity. Control of the profile of the burned hole by choice of concentration and type of gas components is shown possible.

55666 Effect of spatial and temporal modulation of excitation on the output characteristics of gas lasers. Burnashev, M.N.; Privalov, V.E. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **44**: No. 2, 188-191(Feb 1978).

The variable polarization component of the active medium of a gas laser is calculated in the presence of a perturbation in the excitation of the active medium that is dependent on the spatial coordinate and on time. (An example is striations in the capillary of the active element.) Expressions are derived for the variable intensity and frequency components of the gas laser and departures of the output parameters from their stationary values. Numerical estimates are given.

55667 Electrical parameters of the active element of a He—Ne laser. Zabortseva, T.A.; Ryabov, A.I.; Stepanov, V.A. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **44**: No. 2, 192-194(Feb 1978).

Several electrical parameters of the discharge in He, Ne, and a He—Ne mixture are studied under conditions of modulation of the discharge current. The gas laser is represented by an equivalent circuit. A measurement technique is described for the resonance characteristics of the active element. Equivalent capacitance and inductance of the discharge are determined from variation of the characteristics of the active elements induced by connecting a standard capacitance of known value parallel to the discharge tube. Curves of the equivalent capacitance and inductance of the discharge are obtained in the pressure range of 0.5—3.0 Torr in He, Ne, and a He—Ne mixture. It is discovered that impurities in the active element affect the width of the resonance characteristics.

55668 Generation of powerful submicrosecond laser pulses and their use in laser gasdynamics: observation of an optical detonation wave along the beam and penetration of the beam into an absorbing gas medium, generation wave, motion of beam or of beam focus. Askar'yan, G.A.; Manzon, B.M. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 2, 104-108(20 Jan 1978).

We describe generation of high-power laser submicrosecond pulses with the aid of a self-bleaching metallized film in a resonator. The existence of a film-bleaching wave that is caused by delocalization of the radiation and travels with a speed of 10^7 cm/sec is demonstrated, and the possibility of scanning and motion of the focus is estimated. Applications of submicrosecond laser in laser gas dynamics are cited. An optical detonation wave along the beam and penetration of the beam into an absorbing gas medium are observed.

55669 XeCl laser with electron-beam—excited discharge. Bychkov, Y.I.; Karlov, N.V.; Losev, V.F.; Mesyats, G.A.; Prokhorov, A.M.; Tarasenko, V.F. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 1, 34-35(Jan 1978).

The efficiency, output energy, pressure dependence, and voltage dependence of a XeCl laser are reported.

55670 Two-mode locking in a standing-wave gas laser. Gonchukov, S.A.; Ermachenko, V.M.; Petrovskii, V.N.; Protsenko, E.D. (Moscow Engineering-Physics Institute). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 242-245(Aug 1977).

An experimental and theoretical investigation was made of the locking of two orthogonally polarized modes of an He-Ne laser on the neon transitions $3s_2$—$3p_4$, $3s_2$—$3p_2$, and $2s_2$—$2p_1$ in which the angular momenta of the upper and lower levels were 1 and 2, 1 and 1, and 1 and 0 respectively. It was observed that the locking can take place in the region when the modes are symmetrically tuned relative to the center of the gain line. It is shown that in the case of weak degeneracy of the levels of the working transition (with angular moment 1 and 1 or 1 and 0) the mode locking is due to the influence of atomic collisions. Results of investigations of the spectral and polarization characteristics of the radiation in the two-mode locking region are reported.

55671 High-frequency pulse-type light source. Kryzhanovskii, I.I.; Venatovskii, I.V.; Evdokimov, S.V.; Aver'yanov, G.A. *Tr., Leningr. Inst. Tochn. Mekh. Opt.;* No. 88, 83-87(1977). (In Russian).

The proposed pulse-type light source is built on a pulse laser with active modulation of the Q-factor, to produce 4 μs trains of light pulses at frequencies of 25, 50, or 100 kHz (the duration of pulses being respectively 250, 200, and 150 ns). It can be used, for instance, in combination with a model VKF-9 high-speed cinematographic camera. The source of light pulses consists of a radiator and a control mechanism. The optical system of the radiator and the basic controls is shown schematically.

55672 Obtaining increased peak power from tunable modelocked dye lasers. Turner, J.J. Ithaca, NY; Cornell Univ. (1977). 165p. University Microfilms Order No. 78-07,769.

Thesis (Ph. D.).

The design of systems for obtaining increased peak power from tunable modelocked dye lasers is described. For use with modelocked flashlamp pumped dye lasers the method of injection modelocking allows the high powered pulsed laser to be modelocked and its output controlled by injecting a low powered cw modelocked signal into its cavity. A system for achieving high repetition rate cavity dumping of the cw modelocked laser allows the use of the high peak powers existing inside the optical cavity of the laser. The operation of the cw modelocked dye laser is discussed, and various methods for detecting the short pulse output are described. The method of two photon absorption and fluorescence for measuring the pulse width of the cw modelocked laser is made possible by the use of the new dye in this technique. The operation of the injection modelocked flashlamp pumped dye laser is described. Injection modelocking allows an increase in the peak power available from this flashlamp pumped dye laser from 5 kW to 1.5 MW. A comparison of this result with a recent numerical analysis of dye laser injection locking is made. The design and operation of the modelocked cavity dumped dye laser is explained. An increase in peak power from the 150 W of the cw modelocked dye laser to 2.5 kW is obtained, and this output is available at repetition rates to 500 KHz. The use of these high powers in the generation of tunable ultraviolet radiation is described. With the injection modelocked flashlamp pumped dye laser the total ultraviolet energy is 200 times more than that obtained without injection locking. With the cavity dumped laser there is an increase in the average ultraviolet power by 50% from the non-cavity dumped case.

55673 Laser mode analysis. Kwatra, A.P.S. Lubbock, TX; Texas Tech Univ. (1977). 147p. University Microfilms Order No. 78-10,841.

Thesis (Ph. D.).

A new integral equation for optical resonators has been derived from the boundary value problem. This equation, called the Source Integral Equation (SIE), has been solved approximately and mode shapes compared with those from the widely used Fox-Li Integral Equation (FLIE). A double resonance condition (constraints on both mirror separation and transverse dimension) has been obtained from a self-consistency condition. Approximations to the resonance condition have been devised for the limiting case of flat mirrors. The results obtained from a Functional Equation Method (FEM) are compared with traditional computer solutions. The locations of the peaks and valleys agree well and the overall mode shapes are similar. This verifies the utility of the FEM for spherical mirrors of circular aperture. The FLIE and SIE results from the FEM, are compared to confirm the validity of the FEM approach for the SIE. The SIE results are compared to the traditional computer results to find effects of the corrections of the SIE to the FLIE.

55674 Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976). 322p. (CONF-750914—). $14.95.

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

A separate abstract was prepared for each of the individual papers presented at the conference. (TFD)

55675 Frequency up-conversion by laser induced chemiluminescence. Rockwood, S.D. (Los Alamos Scientific Lab., NM). pp 3-7 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Experimental studies of laser-induced chemical reactions of BCl_3 with H_2S have displayed conditions under which a visible luminescence is emitted by the gas mixture. This emission has a component which appears on a time scale shorter than gas kinetic collisions and must be considered as a prerequisite for isotopically selective dissociation. The product responsible for the emission from the BCl_3/H_2S mixture may be preferentially formed in an excited state. This aspect of the emission is discussed. Since the chemical reaction leading to the luminescence is initiated by the absorption of CO_2 laser photons in BCl_3, the net effect is the up-conversion of 10.6 μm radiation to the visible luminescence using chemical energy in the process. (TFD)

55676 Collisional quenching and radiative decay studies of $NF(a^1\Delta)$ and $NF(b^1\Sigma^+)$. Kwok, M.A.; Herbelin, J.M.; Cohen, N. (Aerospace Corp., Los Angeles). pp 8-12 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

$NF(a^1\Delta)$ has been produced by the reaction: $R + NF_2 \rightarrow RF + NF(a^1\Delta)$ (R = H, D, CH_3), and the production of $NF(b^1\Sigma^+)$ by energy transfers: $HF(v > \text{or} = \text{to } 2) + NF(a^1\Delta) \rightarrow HF(v' = v - 2) + NF(b^1\Sigma^+) + 295\ cm^{-1}$, $O_2(a^1\Delta/\text{sub } g/) + NF(a^1\Delta) \rightarrow O_2(X^3\Sigma/\text{sub } g/^-) + NF(b^1\Sigma^+) + 427\ cm^{-1}$. To assess these NF states as candidates for electronic transition chemical lasers, some crucial rate coefficients and radiative decay rates have been measured using the large diameter fast flow tube facility. The emission spectroscopy of these reactive flows has been studied from 300 to 3000 nm. The axial variations of key species concentrations under conditions appropriate for modeling studies have also been observed.

55677 Analysis of visible chemiluminescence from gas phase aluminum oxidation. Kolb, C.E. (Aerodyne Research, Burlington, MA). pp 13-17 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

An intense, visible chemiluminescence is often observed during the gas phase oxidation of Al and Al compounds. This chemiluminescence is usually dominated by a broad, unresolved continuum which peaks between 500 and 600 nm, and often remains above half-peak power at 400 and 700 nm. A brief theoretical treatment of the subject is presented. (TFD)

55678 Recent binary flame chemiluminescence studies at SRI. Edelstein, S.A.; Eckstrom, D.J.; Perry, B.E.; Benson, S.W. (Stanford Research Inst., Menlo Park, CA). CONF-750914—. pp 18-21 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Masssachusetts Institute of Technology (1976).

Recent photon yield measurements include reactions of Sm, Ba, Cs, and Mg with NF_3; Sm and Eu with O_2; and Cs with F_2 and NF_3. Results for these reactions are summarized. (TFD)

55679 Chemiluminescence studies of ternary flame systems for chemical laser potential. Luria, M.; Eckstrom, D.J.; Benson, S.W. (Stanford Research Inst., Menlo Park, CA). pp 22-32 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The chemiluminescence photon yields for a number of polyhalide compounds were measured. The compounds included CCl_4, $GeCl_4$, $SiCl_4$, $SnCl_4$, PCl_3, BCl_3, BI_3, $AsCl_3$ and NF_3. Sodium vapors were mostly used for the reduction, although a few experiments were carried out with lithium. The oxidizers used in this study were N_2O and O_2. Results of the measurements are tabulated. (TFD)

55680 Chemiluminescent excitation of $Na_2(A^1\Sigma/\text{sub } u/^+)$ by sodium-halogen reactions, and laser possibilities in this system. Ham, D.O.; Havens, C.T. (Univ. of Rochester, NY). pp 33-35 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Emission from the $A^1\Sigma/\text{sub } u/^+$ state of diatomic sodium, the red bands, has been observed from reacting mixtures of sodium vapor with several halogen gases. Only a small fraction of the accessible vibration-rotation levels are populated and the same states are populated with all of the halogens. Similar emissions from $K_2(A)$ have not been observed. It is concluded that ground state molecules $Na_2(X)$ are efficiently excited to the A state by absorption of trapped D-line photons emitted by chemically excited sodium atoms. This unique chemiexcitation mechanism is discussed and threshold gain calculations based on the measured characteristics of these emissions are presented to indicate the possibilities of a laser based on this system.

55681 Study of metal-oxide chemiluminescent reactions. Friichtenicht, J.F.; Tang, S.P. (TRW Systems Group, Redondo Beach, CA). pp 36-42 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Reactions of the type $M + N_2O \rightarrow MO^* + N_2$ and $M + NO_2 \rightarrow MO + NO$ where M are various metal atom species have been examined in a crossed atomic-molecular beam apparatus for the purpose of determining their potential applicability to electronic transition laser systems. A considerable amount of information is required to characterize the potential applicability of a particular reaction to a laser system. The approach taken is to conduct a series of rather simple measurements the results of which, when combined, provide a means of identifying promising reactions and those that fail to meet minimum criteria. More detailed measurements may be limited to the more promising reactions thus identified.

55682 Efforts to develop a prototype electronic-transition laser from the chemical reactions of laser-generated metal vapors. Dickson, C.R.; Lee, H.U.; Oldenborg, R.C.; Zare, R.N. (Columbia Univ., New York). pp 43-49 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Laser blowoff as a means of generating metal vapor plumes is a well-known technique. Recently, it has been shown that it is possible to produce intense neutral atom beams with greatly reduced ion content. This is achieved by having the laser beam pass through a glass substrate on which the metal film is deposited, rather than striking the metal surface directly. This technique was used to generate neutral metal vapor in a cylindrical container filled with various oxidizer gases and positioned coaxially with the optical axis of two highly reflective mirrors. A number of candidate laser systems were investigated in a cursory manner. These include Ba + N_2O, Cu + F_2, Sm + N_2O, Sm + F_2, and Sn + N_2O. Results of the study are presented.

55683 Single-collision selective chemical reaction of group III metals (Sc,Y,La) and halogens (F_2,ClF,SF_6,Cl_2). Chalek, C.; Preuss, D.R.; Gole, J.L. (Massachusetts Inst. of Tech., Cambridge). pp 50-55 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Since it seems likely that the production of a given system in an excited electronic state can be accomplished most efficiently by chemical as opposed to electrical means, the development of a visible chemical laser system must be intimatey tied to the understanding of those phenomena which give rise to visible chemiluminescence. An important aspect of research in this area must be the search for chemical reactions which lead to selective population of excited electronic states in a "single collision" step. Selective forma-

tion of a previously unobserved metal halide excited state upon reaction of the Group III metals with the halogenating agents (F_2, ClF, SF_6, and Cl_2) was found. This selectivity is not intimately tied to reaction exoergicity for similar selective ScF production in the reactions of Sc with ClF and SF_6 was found. There is a distinct preference for formation in this newly observed excited state. This set of reactions is believed to represent the first observed example of selective excited molecular electronic state formation via a chemical reaction. (TFD)

55684 Photon yields and spectroscopy of several chemiluminescent germanium atom-oxidizer reactions. Capelle, G.A. (Aerospace Corp., El Segundo, CA); Brom, J.M. Jr. pp 56-59 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Germanium vapor was reacted with N_2O, O_2, NO, and NO_2 in a flowing bath of inert gas at pressures between 0.5 and 20 torr, resulting in a visible flame. The chemiluminescence was identified with three electronic band systems of the GeO molecule: $A^1PI \rightarrow X^1 SIGMA^+$ in the ultraviolet, $a^3 SIGMA^+ \rightarrow X^1 SIGMA^+$ in the blue, and a third previously unreported system, situated between the other two, which was identified as $b^3PI_1 \rightarrow X^1 SIGMA^+$.

55685 Sensing chemically excited metastable populations by CO_2 laser gain measurements. Benard, D.J. (Univ. of California, Santa Barbara). pp 60-67 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Several chemical reactions are known to populate highly excited electronic states resulting in visible chemiluminescence. For chemical laser purposes it is most desirable, however, to populate metastable states which are not easily detected except by a subsequent transfer of energy to a more efficient emitter. For the purposes of evaluating chemical laser possibilities then it would be desirable to monitor the transitions of a molecule which can be nonselectively excited by transfer over a broad range of energy levels. The vibrational states of the CO_2 molecule offer such possibilities. When CO_2 and He are added to a chemiluminescent flame as diluents, electronic to vibrational energy conversion, followed by vibrational relaxation to the fundamental modes result in inversion of the (001 to 100) levels which is detectable by laser gain at 10.6 μm. It is possible by CO_2 laser gain measurements to sense chemically excited metastable populations first in a nonselective way, and then by interaction with a dye laser to selectively determine which states of the product are excited.

55686 Kinetic measurements on the fate of vibronically excited species formed in chemiexcitation reactions: BaO from the Ba/N_2O reaction. Felder, W.; Gould, R.K.; Fontijn, A. (AeroChem Research Labs., Princeton, NJ). pp 68-69 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

In the context of visible chemical laser development, the kinetics for quenching, k/sub Q/, intersystem conversion, k/sub T/, and vibrational relaxation, k/sub v/, of excited BaO formed in the reaction $Ba + N_2O \rightarrow BaO + N_2$ have been measured utilizing the AeroChem high-temperature fast-flow reactor (HTFFR). Methods and techniques developed in this work using this device are applicable to similar measurements on other potential electronic transition chemical laser pump reactions. (TFD)

55687 Electronic-transition photon yields from reactions of Ba(g) with O_2, O_3, N_2O, and NO_2. Fleming, E.S.; Palmer, H.B. (Pennsylvania State Univ., University Park). pp 70-74 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

New results are reported on total electronic-transition photon yields (PHI) of the low-pressure ($0.002 < \text{or} = \text{to} \; p < \text{or} = \text{to}$ approximately 0.2 torr) diffusion flame reactions of barium vapor with the oxidants O_2 and O_3. Revisions of previous results for N_2O and NO_2 as oxidants are also presented. The experimental system and general procedures are described elsewhere, except for an improved method of correcting the photomultiplier output for the spectral intensity distribution of BaO emission that has been used in the present study.

55688 Dependence of Ba + N_2O chemiluminescence cross sections on internal and translational energy. Wern, D.J.; Yokozeki, A.; Menzinger, M. (Univ. of Toronto). pp 75-79 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Little, if anything, is known about the detailed role of reactant internal excitation in electronically nonadiabatic reactions. A pronounced enhancement of the M (Ba; Sm) + $N_2O \rightarrow MO^* + N_2O$ reactions by vibrational excitation was observed. The nu_2 bending mode is shown to be responsible for the effect. It is argued that the first and rate determining process is an electron transfer from Ba into the lowest unoccupied 10a' orbital of N_2O, a process that is facilitated by bending. Subsequent rearrangement of the ion pair can lead to a number of product states that have been invoked to account for the Ba + N_2O spectrum and its change with pressure.

55689 Chemical production of CN(A^2II). Betts, J.A. (TRW Systems Group, Redondo Beach, CA). pp 80-83 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Number densities of the A^2PI state of CN greater than 10^{15} molecules/cm^3 have been observed in a combustion system consisting of H_2, F_2, and either cyanogen or cyanogen chloride. This is equivalent to approximately 10% of the R-CN flow and almost half of the CN(A^2PI) produced is in the $v' = 0$ vibrational level. The experiment utilized a small scale (approximately 100 W) combustion driven HF laser. The precombustor of the device produces F atoms which undergo supersonic expansion into the laser cavity, where they are mixed with the appropriate fuel. The advantage of using this device is that the excited state number densities produced are high enough that lasing threshold would be reached if a population inversion exists. (TFD)

55690 Radiative lifetime of the $A^2\Sigma$ state of SiF. Davis, S.J.; Hadley, S.G. (AFWL, Kirtland AFB, Albuquerque, NM). pp 84 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

In an earlier chemiluminescence experiment it was concluded that the reaction of silane and molecular fluorine may be a promising candidate for an electronic transition chemical laser system. The reaction produces SiF in three electronic states; the ground X^2PI state and the A^2SIGMA and a^4SIGMA excited states. Since the A^2SIGMA state lies between the X^2PI and a^4SIGMA states the possibility of a three level laser system exists. Two key pieces of data needed to quantitatively assess the potential of this system are the radiative lifetimes of the A^2SIGMA and a^4SIGMA excited states. The A^2SIGMA lifetime was determined to be $(2.1 +- 0.2) \times 10^{-7}$ sec. (TFD)

55691 Initiation with an electron beam of chemical reactions of interest for visible wavelength lasers. Whittier, J.S.; Cool, T.A. (Cornell Univ., Ithaca, NY). pp 85-86 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Recent experiments in several laboratories have demonstrated efficient and selective excitation of electronically excited states in the diatomic product molecules of several simple reactions between metal atoms and oxidizers. While chemical laser operation at short wavelengths appears to be feasible for these reactions, several practical problems must be solved before successful laboratory demonstrations are achieved. The difficulties inherent in metal atom production, fluid mixing, and reaction initiation are formidable and require the development of special experimental techniques. The first results obtained with a new shock tube-electron beam facility designed to provide a versatile means for the systematic search for laser operation among several candidate metal atom-oxidizer systems are reported.

55692 Recombinational gasdynamic visible O_2 laser: experimental and theoretical feasibility study. Volvov, A.Y.; Dyomin, A.I.; Kudryavtsev, E.M.; Sobolev, N.N. (Lebedev Physical Inst., Moscow). pp 87-90 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Results of an investigation to determine the possibility of making a laser involving the Herzberg I electronic transition of molecular oxygen are presented. (TFD)

55693 Gasdynamic recombination laser: O_2, Cl_2, Br_2, and NO_2. Wilson, J. (Univ. of Rochester, NY); Bouesc, J.; Fontaine, B.; Forestier, B. pp 91-94 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Of the O_2, Cl_2, and Br_2 molecules, O_2 is the best candidate for a recombination laser with the highest branching ratio, and lowest deactivation, provided the laser can be made sufficiently large to accommodate the low gain. (TFD)

55694 Collisional quenching of excited iodine atoms. Burde, D.H.; Davis, C.C.; McFarlane, R.A. (Cornell Univ., Ithaca, NY). pp 97-104 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Results for the quenching of I^2P/sub 1/2/ by I_2, O_2, H_2O, O_2O, H_2O_2, and CO_2 are given and compared with several rates taken from the literature. (TFD)

55695 Production of population inversions among the electronic states of atomic species by processes of intermolecular V $\rightleftharpoons$ E energy transfer. Blauer, J.A.; Hager, G.D. (Bell Aerospace Co., Niagara Falls, NY). pp 105-111 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

It appears that an approach of V reversible E energy transfer can be used to induce population inversions among the internal modes of atomic species provided that at least a few simple rules are followed. Among these the foremost requirement seems to be that the vibrationally excited molecular species must have a long collisional lifetime and if in near resonance with an electronic transition of the atom must be produced in a totally inverted state. The vibrationally excited H_2 molecule has proven to be a fruitful candidate for study to date.

55696 Relative yield and rate constants for decay of I* produced by photolysis of CH_3I, CD_3I, and $(CF_3)_2AsI$. Padrick, T.D.; Palmer, R.E. (Sandia Labs., Albuquerque, NM). pp 116-118 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Computer fitting of the gain vs time data, with a set of rate equations for the system, has permitted the determination of the fraction of iodine atom dissociated to I* and rate constants for the following reactions: $I^* + RI \rightarrow R + I_2$ and $I^* + RI \rightarrow I + RI$. In the case of CH_3I, the rate constant K_3 for deactivation by CH_3 radicals was also obtained. Results of the determinations are shown in tabular form. (TFD)

55697 Singlet oxygen-iodine transfer laser kinetics. Franklin, R.D.; MacKnight, A.K.; Modreski, P.J. (AFWL, Kirtland AFB, Albuquerque, NM). pp 119-120 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

A model of the kinetics of the singlet oxygen-iodine chemical laser is presented. Experimental efforts to develop an oxygen-iodine laser are described. (TFD)

55698 Electronic-to-vibrational energy transfer reactions: I* + CO. Shortridge, R.G.; Woods, F.J.; Lin, M.C. (Naval Research Lab., Washington, DC). pp 121-124 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The quenching of electronically excited I atoms by CO has been studied in a flash photolytic system employing a cw CO laser probing method. The excited I atom was generated by the photolysis of methyl iodide and several perfluoroalkyl iodides (CF_3I, C_2F_5I, and i-C_3F_7) above 200 nm. Surprisingly, the CO molecule was found to be vibrationally excited up to v = 9 when He was employed as a diluent, and only to v = 3 when SF_6 was used. The detailed CO vibrational population distributions obtained from experiments with 5.0 torr of 1 : 2: 37/CF_3I : CO : He and 1 : 2 : 17/CH_3I : CO : He mixtures, both flashed at 1.0 kJ, are shown. The vibrational temperature of CO was about 3900°K and the average vibrational energy about 4.9 kcal/mole. These findings indicate (1) the excited I atom responsible for the observed CO excitation can be quenched rather effectively by SF_6, but much less so by He; (2) the excited I atom is probably not I(5p^5 P/sub 1/2/) which carries only enough energy to excite CO to v = 3.

55699 New metal atom laser transitions in As, Bi, Ga, Ge, Hg, In, Pb, Sb, and Tl. Chou, M.S.; Cool, T.A. (Cornell Univ., Ithaca, NY). pp 125-147 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Pulsed electrical discharges in metal complexes have been shown to lead to the rapid production of metal atoms of laser interest on a submicrosecond time scale. This technique should be applicable to many additional metal atom laser systems. Of particular interest is the possibility of rapid initiation of chemical laser reactions in mixtures of metal complexes with oxidizers. Additional study is needed of potential visible and ultraviolet laser transitions of high quantum efficiency in several of the metal atoms investigated.

55700 Collision-induced emission from O(^{1}S) and S(^{1}S) by the noble gases, hydrogen, and nitrogen. Black, G.; Sharpless, R.L.; Slanger, T.G. (Stanford Research Inst., Menlo Park, CA). pp 153-157 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Spectroscopic studies have shown that O(^{1}S) forms transient radiating molecular species with the noble gases Ar, Kr, and Xe, which have much larger transition probabilities than the $^1S \rightarrow {}^1D$ atomic transition. This phenomenon, referred to as collision-induced emission, is very important in certain laser applications where an enhanced transition probability is desired. In fact, this characteristic has been recently utilized to obtain laser action on the green bands of XeO and KrO. Although no spectrographic evidence has been found for noble-gas sulfides, the work presented on collisionally-induced emission strongly supports their existence.

55701 Production of O(^{1}S) in e-beam pumped rare-gas/oxygen mixtures. Huestis, D.L.; Gutcheck, R.A.; Hill, R.M.; McCusker, M.V.; Nakano, H.H.; Lorents, D.C. (Stanford Research Inst., Menlo Park, CA). pp 158-161 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Lasing on the XeO(2^{1}SIGMA $\rightarrow$ 1^{1}SIGMA) transition excited in e-beam pumped Xe + O_2 mixtures has recently been demonstrated as well as on the similar transitions of KrO and ArO. The energy transfer kinetics of the XeO production in such media have recently been studied and are briefly discussed.

55702 Transverse discharge metal vapor laser. Wexel, B.L. (Naval Research Lab., Washington, DC). pp 162-165 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

In an effort to explore more efficient devices and to discover new metal vapor lasers, a heatable transverse discharge system with short, fast-rising pulses and high discharge current has been constructed. The transverse discharge geometry should offer significant advantages in scalability and high pressure operation as well. The fast rise time of the discharge is most suitable for investigations of thallium, lead, and a number of other metals with very fast rates for resonance-to-metastable transfer. However, because of the high interest and practical importance of the copper vapor laser, experiments to date have involved only CuCl in the discharge. Previous work in CuCl has involved current rise times extending well beyond the laser pulse, while the highest efficiency will require short discharge pulses. Experiments to date have used helium, neon, or argon as the buffer gas, with neon giving the best results.

55703 Gain measurements on th 1.5 μm Ba(^{1}P $\rightarrow$ ^{1}D) transition in a Ba + N_2O reactive flow. Djeu, N. (Naval Research Lab., Washington, DC). pp 166-169 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

For purposes of gain diagnostics, an attempt was made to achieve cw laser action on the 1.5 μm line by optically pumping Ba vapor at 5535 A. The attempt was successful when a cw dye laser was used to pump Ba vapor in the presence of a few torr of N_2. Using N_2 as quenching gas, the optically pumped Ba laser produces several milliwatts at a photon conversion efficiency of approximately 30%. (TFD)

55704 Chemiexcitation transfer from metastable molecules to metal atoms in metal-halogen flames. Rosenwaks, S.; Broida, H.P. (Univ. of California, Santa Barbara). pp 170-177 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

Emission was observed from Al, Cu, and Pb atoms following chemical reactions of the metal with halogens. It is suggested that the metal atoms are excited by energy transfer from metastable states of molecules formed in the reactions. (TFD)

55705 Analytical studies of the mechanisms of chemiluminescence. Eckstrom, D.J.; Huestis, D.L.; Edelstein, S.A.; Benson, S.W. (Stanford Research Inst., Menlo Park, CA). pp 296-299 of Electronic transition lasers. Steinfeld, J.I. (ed.). Cambridge, MA; Massachusetts Institute of Technology (1976).

From 2. summer colloquium on electronic transition lasers; Woods Hole, MA, USA (17 Sep 1975).

The development of an analytical model for chemiluminescence is briefly described. (TFD)

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 54990, 54997, 55001, 55047, 55122, 55142, 55177, 55384

55706 (AD-A—050306) **A physical model for computing fluid flow solutions. Final report.** Wright, W.P. (Ballistic Research Labs., Aberdeen Proving Ground, MD (USA)). Sep 1977. 74p. (BRL—2012). NTIS PC A04/MF A01.

A physical and mathematical scheme is described which can be the basis for the construction of a computer program designed to solve fluid flow problems important to the U.S. Army. Essentially the scheme consists of the determination of contributions of moments of physical quantities over Lagrangian cells of fluid, which move according to the local fluid velocity to neighboring fixed cells. Based on the sums of these contributions of moments, new distributions across the fixed cells are determined which correspond to fluid flow during an elapse of a finite interval of time. The moments of the physical quantities over subregions of the Lagrangian cells are evaluated by utilizing a set of integral equations which are derived in the report.

55707 (COO—4155-5) **Nonlinear Rayleigh-Taylor stability with mass and heat transfer. II. Finite fluid layers.** Hsieh, D.Y. (Brown Univ., Providence, RI (USA). Div. of Applied Mathematics). May 1978. Contract EG-77-S-02-4155. 12p. Dep. NTIS, PC A02/MF A01.

The nonlinear Rayleigh-Taylor stability of a liquid layer over a finite vapor layer was studied using a simplified formulation of the problem. The method of multiple scale expansion was employed for the investigation. It was found that when the heat transfer rate is strong enough, the classically unstable system is stabilized by the nonlinear effect and the effect of mass and heat transfer across the interface. A simple nondimensional parameter is also found to characterize the stability of the system.

55708 (DP-MS—78-53) **Numerical solutions for a general set of problems by an alternating strongly implicit procedure.** Pepper, D.W.; Cooper, R.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1978. Contract EY-76-C-09-0001. 9p. (CONF-780712—6). Dep. NTIS, PC A02/MF A01.

From Conference on numerical methods in laminar and turbulent flow; Swansea, UK (18 Jul 1978).

A generalized numerical method is developed for analyzing the following problems: driven laminar flow past a square cavity, laminar flow past a cylinder located in an infinite fluid, transient analysis of the preceding problem, and heat transfer in driven laminar flow past a cavity.

55709 (NTIS/PS—78/0258) **Cavitation. Part 1. Cavitation flow. Volume 2. 1974-February 1978 (a bibliography with abstracts). Report for 1974-Feb 78.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 192p.

The bibliography includes reports on general aspects of cavitating flow. A wide range of theoretical, analytical, and experimental information is presented involving mathematical analysis, computer programs, and testing. Topics include marine engineering, hydrodynamic and aerodynamic configurations, symmetric and nonaxisymmetric shapes, and measuring technology. Data are given on surface piercing struts, helical inducers, pumps, liquid metal systems, and venturi tubes. Applications include dam outlets and spillways, vertical conduits, deep rock drilling, heat pipe stability, water entry, and liquid cryogenic systems. Discussions are made of flow characteristics, noise, nucleate boiling, perturbation problems, and allied subjects. Cavitation related to turbines, propellers, rudders, cavities, and hydrofoils is not included. These topics, and materials on cavitation corrosion and erosion, are covered in other associated bibliographies. (This updated bibliography contains 187 abstracts, 55 of which are new entries to the previous edition.)

55710 (NTIS/PS—78/0260) **Cavitation. Part 3. Corrosion and erosion (a bibliography with abstracts). Report for 1964-Feb 78.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 132p.

Corrosion and erosion effects of cavitation are documented. Many research areas are covered, with the exception of turbines, which are reported in Part 4 of this series. Studies are presented on marine propellers, pumps, dams, and spillways. Space power systems are included. The discussions refer to bubble and microbubble investigations, concepts and theories of damage, scaling laws, mathematical models, numerical analysis, and computerized simulation. Studies are given of erosion prevention, hydroabrasive wear, metal and elastomeric surface protection, and raindrop resistance. Other topics are vibration, liquid-solid interfaces, viscoelasticity, dissolved and contained gases, and flow fields, such as cryogenic, liquid metal, and multiphase. Test equipment, methods, models, and findings are described. (This updated bibliography contains 127 abstracts, 10 of which are new entries to the previous edition.)

55711 Volumetric calibration of experimental apparatus by xenon gas transfer. Rutherford, W.M. (Monsanto Research Corporation, Mound Laboratory, Miamisburg, Ohio 45342). *Rev. Sci. Instrum.;* **49**: No. 10, 1415-1417(Oct 1978).

The volumes of interconnected sections of large, irregular, or inaccessible apparatus can be measured by quantitative cryogenic transfer of a xenon gas fill to weighing bottles. Tests with eight containers from 75 to 10 000 cm^3 using relatively simple equipment, showed that: (1) absolute volumes of 250 cm^3 or larger can be measured with a reproducibility on the order of 0.02% and with an accuracy on the order of 0.05% and (2) the ratios among two or more volumes can be determined with a reproducibility of 0.01%—0.001%, depending on volume.

55712 Comparison of gas and vapour bubble neculeation on a brass surface in water. Eddington, R.I. (Oxford Univ.); Kenning, D.B.R.; Korneichev, A.I. *Int. J. Heat Mass Transfer;* **21**: No. 7, 855-862(Jul 1978).

The size distribution of naturally occurring nucleation sites on a heater surface was determined by two experimental techniques—gas bubble nucleation as gas diffused out of a supersaturated solution and vapor bubble nucleation in boiling. Many more sites were active in gas diffusion than in boiling and the probable reasons for this are examined. The effective radii of individual sites were calculated from both sets of data. Finally, the sites were located and photographed by scanning electron microscope.

55713 Numerial prediction of heat-transfer characteristics of fully developed laminar flow through a circular channel containing rod clusters. Benodekar, R.W.; Date, A.W. (Indian Inst. of Tech., Bombay). *Int. J. Heat Mass Transfer;* **21**: No. 7, 935-945(Jul 1978).

The results of computations for a fully developed laminar flow in rod cluster assemblies are presented. The problem is solved by a finite difference method using a sector approach, where only the smallest symmetry segment of the cluster is considered to be the characteristic flow area. The pressure drop characteristics are reported in terms of friction factor Reynolds number products and are compared with those available in the literature. Nusselt numbers are presented for several configurations. The results are expressed as functions of channel wall spacing, radial displacement of the rod rings, the number of rods in the assembly and rod diameters.

55714 Pressure drop in the flow of gas/steam liquid mixtures in pipes. Friedel, L. (Farbwerke Hoechst A.G., Frankfurt am Main (Germany, F.R.)). *Chem.-Ing.-Tech.;* **50**: No. 3, 167-180(Mar 1978). (In German).

From Annual meeting of the process engineers and 192. event of the Europaeische Foederation fuer Chemie-Ingenieur-Wesen; Stuttgart, Germany, F.R. (28 - 30 Sep 1977).

Pressure drop in two phase flow is considered to be made up of terms for geodetical elevation or depression, acceleration, and friction. The geodetical and momentum pressure drop are discussed and reasonable correlations are presented, along with their limitations and range of application. Various relationships are available for calculating the technically important friction component. If purely empirical correlations are neclected, all the remaining predictive schemes can be related to three basic physical models. These models as well as the commonly accepted and most reliable relationships are discussed and classified according to type. Furthermore, their scope is defined and the accuracy of prediction systematically compared with the aid of a newly set-up data bank. The extensive literature data consulted refer to single component two phase flow of water and various refrigerants and several two-component systems in horizontal and vertical unheated straight pipes under industrially relevant flow conditions. Finally, the accuracy of the prediction of some generally accepted void correlations is dealt with: here too, numerous published void fraction data have been gathered and checked.

55715 Relation between varying measuring results of two-phase flow losses. Ledinegg, M. *Brennst.-Waerme-Kraft;* **30**: No. 1, 11-18(Jan 1978). (In German).

Tests on the pressure drop of two-phase flow show very different results, a fact which is caused mainly by the numerous parameters. Usually, the object of the investigation is the local pressure drop which is apparently somewhere between certain maxima and minima. The maxima correspond approximately to the results of Lockhart and Martinelle. The paper deals not only with the local pressure drop, but mainly with the total value which is more interesting in connection with technical problems. It shows that the position between a maximum and a minimum is determined by the pipe inclination and the pressure, as well as by the Froundnumber. By using as a model the layer flow, equations are derived for extreme cases which allow the correct value of the total pressure drop to be given, with the help of a factor which is found from test results.

55716 Criteria to be observed and open questions in connection with organic heat carrier media. Wagner, W. (Konus-Kessel, Schwetzingen (Germany, F.R.)). *Waerme;* **83**: No. 6, 89-92(Dec 1977). (In German).

Layout of heat transfer systems especially according to DIN 4754 has greatly improved the operational safety of such systems. The main drawback of organic heat carriers, their inflammability, has been reduced to a very small 'residual risk' by systems which are nearly completely welded. It should be noted that organic heat carriers, in particular synthetic ones, are of increasing importance in solar energy conversion. The article points out some criteria to be observed and some special characteristics of organic heat carriers and mentions standard criteria of assessment which remain to be established.

55717 Method to measure mass flows of stationary and non-stationary two-phase flows, as well as equipment to perform the method. Loeffel, R.; Wolf, E. (to Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). German(FRG) Patent 2,614,923/A/. 27 Oct 1977. 13p. (In German).

In order to measure multi-phase flows in pipes, even in those of large diameter, a suggestion is made to inject radioactive tracers into the flow to be investigated, separate for each phase, and at a distance from the position of injection, to measure the activities of the injections whilse the density of the phase mixture is determined with a gamma absorption process. ^{41}Ar (gas phase) and ^{56}Mn (liquid phase) were used as tracers. The equipment having a pressure-supplying and injecting device is described in detail.

55718 Device for the drying of wet steam and subsequent superheating of the dry steam. Doerling, R.; Westebbe, K. (to Steinmueller (L. u. C.) G.m.b.H., Gummersbach (Germany, F.R.)). German(FRG) Patent 2,555,538/A/. 23 Jun 1977. 9p. (In German).

According to the invention, the efficiency of plants for the drying and subsequent superheating of wet steam can be improved by separating the drying and superheating zones, thus avoiding strain and deformation of the container. The zones are separated by arranging superheater elements inside the device (which has a rough separator at the bottom of a standing cylindrical vessel and a fine separator in its upper part) around a concentric duct above the fine separator. The superheater elements run parallel to the axis of the vessel until just below the top.

55719 Analogue of the Reynolds criterion for boiling. Vishnev, I.P. *Inzn.-Fiz. Zh.;* **32**: No. 5, 789-799(May 1977). (In Russian).

An analog of the Reynolds criterion for boiling is proposed along with a generalized equation of heat exchange, for describing nucleate boiling in pipes and in a large volume. The initial system of ten equations, describing the hydrodynamic, thermal and thermodynamic aspects of the boiling process under various conditions adequately enough, has been processed using the theory of similarity, and a criterial relationship was derived for the case of a predetermined heat flow density. The criteria given permit the hydrodynamics and heat exchange during boiling in pipes and channels with boiling in tubular members and in a large volume to be interrelated by common regularities, as well as such types of apparatus to be designed using a common approach and a common generalized formula.

55720 Application of the annular dispersed flow model to two-phase critical flow calculation. Ivandaev, A.I.; Nigmatulin, B.I. (Moskovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Inst. Mekhaniki). *Teplofiz. Vys. Temp.;* **15**: No. 3, 573-580(1977). (In Russian).

The application of the annular dispersed flow model with an effective monodisperse core to the calculation of vapour-liquid mixture maximum rates through long pipes is discussed. An effect of the main dominant parameters such as evaporation intensity, diameter of drops picked out from the film surface and initial drop diameter at the pipe inlet on the outlet critical condition formation process has been investigated. The corresponding model constants have been determined. The calculated and experimental values of critical rates and pressure profiles along the channel have been found to be in a satisfactory agreement in the studied range of parameters. The observed non-conformity of the calculated and experimental values of critical pressures and vapour contents can be due to inadequate accuracy of the experimental techniques.

55721 Application of semiempirical models for calculating heat transfer in turbulent flow of one-phase near-critical coolants in tubes. Petukhov, B.S.; Vilenskij, V.D.; Medvetskaya, N.V. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). *Teplofiz. Vys. Temp.;* **15**: No. 3, 554-565(1977). (In Russian).

Numerical investigation of heat exchange for the turbulent flow of coolants inside a round pipe with a significant dependence of the physical properties on temperature, was carried out on the basis of energy, motion and continuity equations expressed as boundary layer equations. The problem was solved for the case when the wall heat flux is a constant value along the pipe. The two-layer six-point implicit difference scheme was employed. The numerical solution results are compared with experimental data obtained for water and carbon dioxide coolants with near-critical parameters. The comparison showed that in the case of a significant effect of thermal gravitation and thermal acceleration or physical properties of the coolants, the discrepancy between the computed and experimental data reaches 100% and more. The discrepancy is caused by the fact, that turbulent transfer models considered do not permit the taking into proper account the effect of physical property changes on the turbulent transfer.

55722 Experimental study on supercritical heat transfer in steam generating channels with smooth and rough surfaces. Styrikovich, M.A.; Leont'ev, A.I.; Polonskij, V.S.; Malashkin, I.I. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). *Teplofiz. Vys. Temp.;* **15**: No. 3, 566-572(1977). (In Russian).

An experimental investigation of the effect of steam generating channel roughness on the heat transfer efficiency was carried out. A disperse regime of the vapour-water flow was studied. The vertical experimental section was made as an 8 mm diameter pipe roughed with a single-start thread. The thread was of a triangular cross-section with 45 μ height and 450 μ pitch. The experiments were carried out in the following parameter range: pressure - 68 to 186 bar, heat rate - 400 to 1280 kW/m^2, mass velocity - 700 to 1250 kg/m^2xs. It was found, that the roughness efficiency increases with the mass velocity and heat rate increasing and decreases with the pressure increasing. The Nusselt number on the roughed pipe is four-times higher in comparison with the smooth one.

55723 Determination of the rules of interaction between components of a gas—liquid dispersed circular stream. Ivandaev, S.I. pp 196-204 of Nelineyn. volnov. protsessy v dvukhfaz. sredakh. Novosibirsk, USSR; Institut Teplofiziki (1977). (In Russian)

A study is made of the disperse-circular flow mode of gas-liquid streams within the framework of a three-velocity model. Based on analysis and processing of experimental results by various authors, equations are produced for the forces of friction of the film against the wall and the gas core and the intensity of precipitation of drops onto the wall of a pipe. It is shown that for forces of friction of the film against the wall of the pipe, equations can be used which are produced for films running freely down a flat wall. The force interaction of the gas core with the surface of the film is schematized by a flow in a rough pipe; an equation is presented for equivalent roughness of the film. Considering the relationships produced for the forces and intensity of precipitation of drops from the core of the stream, the problem of precipitation of drops onto the dry wall of a pipe is numerically solved. The numerical and experimental data agree satisfactorily.

55724 Accounting for the effect of concentration on the inertial interaction between components in a two-phase mixture. Srebnyuk, S.M.; Chernyy, I.M. *Vopr. Gazotermodin. Energoustanovok;* No. 3, 81-82(1976). (In Russian).

Results are presented of an experimental study which was made to determine the effect of the concentration of a discrete phase on the apparent-mass factor for a unit sphere. The stream of a discrete phase was simulated by a three-dimensional regular array of spherical bodies. The tests were performed on a special stand with a high-frequency vibrator (by the method of frequency characteristics), where the concentration could be varied over the 0.05 to 0.45 range. The results of this study are compared with the theoretical solution to the Lamb-Zuber equation for a cellular model, with M. Pauli's exact solution for a unit chain, and with the results of studies by the method of EHD analogy. The data are approximated to fit a simple analytical relation and can be used for refining the design of nozzles for operation with gas-liquid mixtures.

55725 Mathematical and experimental study of fields of deformations and displacements with plastic shape change. Lisitsyn, A.I.;

Lisitsyna, E.A. *Tr., Chelyab. Politekh. Inst.;* No. 182, 154-163(1976). (In Russian).

Correlations are presented between the characteristics of light scattered by spherical dispersed particles and integral parameters (total diameter, total surface and volumetric concentration) of the dispersed phase of gas-liquid streams. For a number of models related to changes in the spectrum of dimension of the particles with time, equations are found allowing these changes to be determined on the basis of measurement of integral and instantaneous characteristics of light scattering. This eliminates the cumbersome stage of determining the spectrum of dimensions at each moment in time. It is shown that for singly dispersed particles of identical shape and orientation, it is possible to determine the form from the scattering index. For symmetrical particle shapes, the problem of determination of form is reduced to a Fourier cosine transform.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 55475

55726 (LA—7330-MS) **Time-resolved PHERMEX image restorations constrained with an additional multiply-exposed image.** Kruger, R.P.; Breedlove, J.R. Jr.; Trussell, H.J. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 19p. Dep. NTIS, PC A02/MF A01.

There are a number of possible industrial and scientific applications of nanosecond cineradiographs. Although the technology exists to produce closely spaced pulses of x rays for this application, the quality of the time-resolved radiographs is severely limited. The limitations arise from the necessity of using a fluorescent screen to convert the transmitted x rays to light and then using electro-optical imaging systems to gate and to record the images with conventional high-speed cameras. It has been proposed that, in addition to the time-resolved images, a conventional multiply exposed radiograph be obtained. This report uses both PHERMEX and conventional photographic simulations to demonstrate that the additional information supplied by the multiply exposed radiograph can be used to improve the quality of digital image restorations of the time-resolved pictures over what could be achieved with the degraded images alone.

55727 (LA-UR—78-1600) **New method for calculating elastic wave scattering by a flaw.** Visscher, W.M. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 36p. (CONF-780650—5). Dep. NTIS, PC A03/MF A01.

From 1. symposium on ultrasonic materials characterization; Gaithersburg, MD, USA (7 Jun 1978).

Portions of document are illegible.

The displacement vector is expanded in orthogonal functions which satisfy the equations of motion for the elastic medium. The coefficients in the expansion are determined by the requirement that the square of the deviance from the boundary conditions, integrated over the surface of the flaw, be a minimum. This leads to a set of linear equations for the coefficients. A program has been written which computes direct and mode-converted scattering from axially symmetric rigid obstacles and voids. Examples are exhibited, including direct and mode-converted scattering from spheres, oblate and prolate spheroids, cones, and pillboxes, with ka varying from .01 to 10, and aspect ratios up to 7. It is concluded that this is an efficient and practical method for calculating elastic-wave scattering.

55728 (UCRL—81338) **Ultrasonic Imaging Project and test bed.** McKinley, B.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jul 1978. Contract W-7405-ENG-48. 6p. (CONF-780736—1). Dep. NTIS, MF A01.

From ARPA/AFML review of progress in quantitative NDE; LaJolla, CA, USA (18 Jul 1978).

Portions of document are illegible.

The Lawrence Livermore Laboratory (LLL) Ultrasonic Imaging Project is described. The project's purpose is to increase resolution and produce accurate graphic ultrasonic images. Sub projects directed at achieving these goals are: (1) mathematic modeling of elastic wave scattering for realistic defects; (2) developing signal analysis techniques to allow thorough quantitative ultrasonic field measurements; and (3) design and fabrication of a high precision, versatile, computer controlled two-transducer ultrasonic test bed with on-line computerized data acquisition, analysis, and image display. Improved methods for quantitative evaluation of bond strength, cracks, and joining are required by current LLL programs. From these requirements the necessity for a two transducer test bed has become evident. The major emphasis of this paper is to describe the sophisticated new concept in ultrasonic test beds now under development.

55729 **Setup and organization of quality control.** Fischer, U. *VDI (Ver. Dtsch. Ing.) Z.;* **120**: No. 10, 451-461(May 1978). (In German).

Enterprises are compelled to extensive measures for the guarantee of quality. Therefore, the creation of a special range, being particularly competent for questions of quality, is of considerable importance. Should this range be efficient, it then must be able to influence the individual fields of production. This, however, requires a corresponding setup and flow organization, and indeed particularly in cases in which one wants to master the quality inspection and the quality control at the single piece and the short-run production. A form of organization is presented which satisfies this requirement. This form of organization distinguishes itself from other things by the fact that it can be accommodated practically to the structure of every enterprise.

55730 **Model experiments for detecting faults in pipes. Investigations of the reflection of ultrasonic pulses in parallel artificial inclusions.** Riefel, J.; Schneider, H. (Mannesmann-Forschungsinstitut G.m.b.H., Duisburg (Germany, F.R.)). *Baender, Bleche, Rohre;* **19**: No. 4, 173-176(Apr 1978). (In German).

The reflection behaviour of non-metallic inclusions was investigated using inclusion models. The investigations showed that ultrasonic pulses can be reflected with the same intensity from inclusions which lie parallel to the surface of the pipe as from welding faults. Investigations of these artificial inclusions, therefore, gave some idea as to how to avoid indications of non-metallic inclusions or how to deal with them specifically.

55731 **Principles and applications of the thermography in the technical field.** Erfurth, M. (Atomika Technische Physik G.m.b.H., Muenchen (Germany, F.R.)). *Mess. Pruef.;* No. 4, 162-188(Apr 1978). (In German).

Thermographic recording and visualization of temperature entropy diagrams, temperature distributions, and dynamic temperature changes on object surfaces may be represented with quality at the present state of the infrared technique. This novel method exceeds the conventional temperature measuring method by several orders of magnitude as far as economy, versatility, and significance of the results are concerned. The physical principles of thermal radiation is described and the performance criteria of commercial thermography equipment are compared. In some examples of application, the possibilities and limits of this young technology are discussed.

55732 **Tendencies in future quality assurance.** Uebing, D. *Tech. Ueberwach.;* **19**: No. 4, 109-112(Apr 1978). (In German).

A comprehensive view is presented of the special importance of quality assurance in connection with complex large-scale plants. Measures assuring quality accompany projects from the conception to startup and beyond. Books of rules set up basic requirements which have to be improved upon if special operational conditions call for it. Quality assurance is seen as system-oriented and product-oriented, and American (ASME) and German (TUeV) practices are compared. In order to achieve interdisciplinary uniformity, quality 'stages' are proposed which should be specified by a commission at Federal level. Bearing in mind fallibility of man and his time-dependent vigilance, examination redundancy and examination diversification are included in considerations concerning safety and economy.

55733 **Testing of concrete steels under frequently varying loads.** Harre, W. *Beton Stahlbetonbau;* **73**: No. 2, 47-49(Feb 1978). (In German).

In reinforced-concrete construction, the wish to make optimum use of the materials and the need to minimize costs have led to more sophisticated constructions and to better components. As a result, the amount of variable load with regard to the total load becomes higher in components which are not subject mainly to stationary loards, e.g. bridges, craneway constructions, floors, etc. This means an increasing importance of the problem of materials behaviour under variable loads also in reinforced-concrete construction. This finding has lately been taken into account by the fact that in addition to regulations concerning the dimensions, quality assurance in the form of certain characteristic values for fatigue limits is now required for concrete steels.

55734 **Choice of optimum equipment set for radiation laboratory.** Gorbunov, V.I.; Berdonosov, V.A.; Dobner, B.A.; Dobner, L.M.; Shkarina, G.T. (Nauchno-Issledovatel'skij Inst. Ehlektronnoj Introskopii, Tomsk (USSR)). *Defektoskopiya;* No. 3, 114-116(1977). (In Russian).

An attempt has been made to elaborate an algorithm which helps to determine on the basis of annual production, the items of the equipment and their quantity required for a radiation laboratory so that expenses for the program control would be minimized. The problem is considered as applied to radiation control of welds of engineering articles. Initial data required for the algorithm elaboration are presented.

55735 Analysis of the conditions ensuring three-dimensional effect in stereoscopic radiation systems. Gorbunov, V.I.; Petushenko, V.F.; Sviryakin, D.I. (Nauchno-Issledovatel'skij Inst. Ehlektronnoj Introskopii, Tomsk (USSR)). *Defektoskopiya;* No. 3, 7-11(1977). (In Russian).

Based on the analysis of work devoted to radiation stereoscopy, serious faults are discussed in approach to the radiation stereoscopic systems, which entail errors in determination of the reasons for development of the artificial stereo-effect and in derivation of the formulas for the basic parameters. It is experimentally shown that the main depth symptom on the stereo-couple is represented by the differential parallax rather than by the absolute values of the projections. The position and role have been determined of the differential parallax on the stereo-couple in the physiological process of image fusion.

55736 Flaws in pipes and pipe joints and their rating under pulsating internal pressure. Jaeger, P. *Three R Int.;* **16**: No. 11, 696-699(1977). (In German).

Based on the size of discontinuities in welded longitudinal and girth joints of pipe, it is shown how specific sizes of discontinuities can be reliably detected. In conjunction with the method used for determing the number of load cycles which a pipe with defective welds can undergo under pulsating internal pressure, this procedure makes it possible to quantitatively asses the reliability of long-distance piping under actual service conditions.

55737 Use of selenium electro-x-ray plates in gamma radiography of steel and aluminium alloys. Kaminskas, A.I.; Varanetskas, I.P. *Defektoskopiya;* No. 3, 17-20(1977). (In Russian).

Exposure conditions and sensitivity have been experimentally studied of the method of steel and aluminum alloy inspection by ^{137}Cs and ^{192}Ir gamma rays on SERP-100P and SERP-100P 2 selenium plates. It is established that employment of the SERP-100P 2 plates gives equal or even better results than employment of RT-1 and RT-5 x-ray films. SERP-100P plates yield somewhat worse results as compared to the above x-ray films.

55738 X-ray radiography of steel using TV system on x-ray vidicons. Semenov, A.P.; Volkov, A.V. (Nauchno-Issledovatel'skij i Konstruktorskij Inst. Montazhnoj Tekhnologii, Moscow (USSR)). *Defektoskopiya;* No. 3, 12-16(1977). (In Russian).

The capability of the x-ray television set for inspection of the steel items with use of various radiation sources and various types of x-ray vidicons was studied. It is shown that the x-ray television set with changeable x-ray vidicons and various radiation sources may be employed for inspection of steel, 30-32 mm thick. To ensure maximum sensitivity of the system, a definite radiation level should be provided on the target of the x-ray vidicon. The optimum conditions for steel inspection with the use of the x-ray television set are determined by the relationship of Psub(m)=f(h) (where Psub(m) is the dose rate of the x=ray irradiation on the target of the x=ray vidicon, h is the thickness of the absorber), and by the absorption curves. The tests have been carried on 1Kh18N9T steel.

55739 Use of signal analysis to identify sources of acoustic emission. Woodward, B. (Loughborough Univ. of Technology (UK). Dept. of Electronic and Electrical Engineering); Harris, R.W. (Australian Atomic Energy Commission, Sydney). *Acustica;* **37**: No. 3, 190-197(1977).

Acoustic emission occurs in a metal when an applied stress causes movement of flaws. The magnitude and frequency content of each emission 'burst' generated depend on the nature of some source mechanism, and provided the characteristics of the propagation path between the source and a detecting transducer are definable and substantially constant an analysis of individual bursts should allow the various source mechanisms to be identified. The analysis procedure chosen was to obtain the amplitude spectral density for each burst and to identify this by computing a single parameter, the median frequency, i.e. the frequency which divides the spectrum into two equal areas. A series of experiments was carried out using zirconium specimens, and the experimental results indicated that three separate metallurgical mechanisms produced acoustic emissions. The results also indicated that one of these mechanisms was dominant. A concurrent metallurgical examination showed that a large amount of twin initiation took place and that there were smaller amounts of twin broadening and slip.

SAFETY ENGINEERING

55740 (SAND—78-0581) **Approach to incorporating proven quality assurance, reliability, and human factors principles into industrial safety programs.** Ellingson, A.C.; Trauth, C.A. Jr.; Jercinovic, L.M.; Farr, D.E. (Sandia Labs., Albuquerque, NM (USA)). Jun 1978. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

This report summarizes the findings resulting from a comparison of the Industrial Safety Program administered by the Sandia Safety Standards and Engineering Department with a model Environment, Safety, and Health Assurance Program which is based upon proven quality assurance, reliability, and human factors principles and practices. The comparison upon which the report is based is a preliminary evaluation of what changes, if any, would be needed in the existing Sandia Laborators Industrial Safety Program if it were to become an assurance program. While the issue is addressed only in the context of our own industrial safety program, the approach presented appears to be generally applicable.

55741 Zur Wahl eines einheitlichen Sicherheitskonzeptes fuer den konstruktiven Ingenieurbau. (Selection of a uniform safety concept for constructive civil engineering). Pottharst, R. Berlin, Germany, F.R.; Ernst (1977). 142p. (In German).

A critical look is taken at various approximations for the definition of an equivalent measure for failure probability; proposals for a uniform design concept; safety factors for the fracture safety proof of reinforced concrete constructions and for the determination of the fracture stress resultant; and examination of the safety level of the proposed design concept by comparing it with existing standards.

ELECTRONIC CIRCUITS AND DEVICES

55742 (LA—7377-M) **Analog 4-MHz fiber-optics link.** Noel, B.W. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 13p. Dep. NTIS, PC A02/MF A01.

An analog 4-MHz fiber-optics link was designed to send multiplexed FM data over low-loss fiber-optics cable. This operating manual provides specifications, discusses application limitations and design changes required to improve the specifications, describes the link components, and gives instructions for field setup.

55743 (UCRL—81151) **Interaction between protocol levels in a prioritized CSMA broadcast network.** Donnelley, J.E.; Yeh, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1978. Contract W-7405-ENG-48. 22p. (CONF-780828—1). Dep. NTIS, PC A02/MF A01.

From 3. workshop on distributed data management and computer networks; San Francisco, CA, USA (29 Aug 1978).

Discrete event simulation studies of the Hyperchannel product of the Network Systems Corporation demonstrate surprising performance variations resulting from rather subtle protocol, timing, and topology changes. Early analytic and simulation studies showed the effectiveness of the lowest-level Hyperchannel contention mechanisms. Later simulations, including the next level of microcoded error and flow control protocols, showed that great care must be taken to maintain high trunk utilization through both protocol levels. Examples of performance degradation arising from interaction between the two protocol levels illustrate the type of information that can be obtained from simulation analysis of communication systems too complex for current state-of-the-art mathematical models. 20 figures.

55744 Automatically sweeping dual-channel boxcar integrator. Keefe, D.J.; Patterson, D.R. (Electronics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Rev. Sci. Instrum.;* **49**: No. 10, 1388-1391(Oct 1978).

An automatically sweeping dual-channel boxcar integrator has been developed to automate the search for a signal that repeatedly follows a trigger pulse by a constant or slowly varying time delay when that signal is completely hidden in random electrical noise and dc-offset drifts. The automatically sweeping dual-channel boxcar integrator improves the signal-to-noise ratio and eliminates dc-drift errors in the same way that a conventional dual-channel boxcar integrator does, but, in addition, automatically locates the hidden signal. When the signal is found, its time delay is displayed with 100-ns resolution, and its peak value is automatically measured and displayed. This relieves the operator of the tedious, time-consuming, and error-prone search for the signal whenever the time delay changes. The automatically sweeping boxcar integrator can also be used as a conventional dual-channel boxcar integrator. In either mode, it can repeatedly integrate a signal up to 990 times and thus make accurate measurements of the signal pulse height in the presence of random noise, dc offsets, and unsynchronized interfering signals.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 54800, 54814

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 54496, 54498, 54899, 55317

55745 (ANL/CEN/FE—77-11) **Support studies in fluidized-bed combustion. Quarterly report, October—December 1977.** Johnson, I.; Vogel, G.J.; Lee, S.H.D. (Argonne National Lab., IL (USA)). 1977. Contract W-31-109-ENG-38. 65p. Dep. NTIS, PC A04/MF A01.

This work supports the development studies for atmospheric and pressurized fluidized-bed coal combustion. Laboratory and bench-scale (process development) studies are aimed at providing needed information on limestone utilization, control of emission of alkali metal compounds and SO_2 during combustion, particulate loadings of flue gas, and other aspects of fluidized-bed coal combustion. Characterization of a variety of limestones and dolomites from various parts of the United States for suitability for use in fluidized-bed combustors for SO_2 emission control is also being done. Reducing the volume of solid wastes to reduce their environmental impact is a major goal. The development of methods for controlling the composition of hot flue gas so that it is a suitable feed gas for gas turbines is another major aim. These studies are designed to supply data and new concepts essential for the timely application of fluidized-bed combustion units to public utility and industrial systems.

55746 (HCP/T2463—21) **Industrial application: fluidized bed combustion process. Quarterly report, January—March 1978.** (Flui-Dyne Engineering Corp., Minneapolis, MN (USA)). Jul 1978. Contract EX-76-C-01-2463. 19p. Dep. NTIS, PC A02/MF A01.

Effort was concentrated on Technology Support, and the Design of the Demonstration Plant. A "test plan" describing additional tests in the Vertical Slice Test Facility was completed and submitted to DOE. Effort was also concentrated on modifying equipment as required for the proposed testing. Work on completion of the system design continued. A cost estimate based on the 80% design submittal was completed and submitted to DOE.

55747 (ORNL/TM—6334) **Effects of alternate fuels. Report No. 6. Analysis of low-alumina castable refractory degraded by residual oil combustion products.** Wei, G.C.; Tennery, V.J. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. 34p. Dep. NTIS, PC A03/MF A01.

This is the sixth of a series of reports on analyses of several types of refractories used in industrial furnaces with fuels considered alternate to natural gas. Analyses were performed on a low-alumina castable used for only two months in the roof of a residual-oil-fired boiler. The maximum hot-face temperature during operation was about 1530°K. The original microstructure of the castable, which consisted of mullite aggregate bonded with iron-containing gehlenite ($2\,CaO \cdot Al_2O_3 \cdot SiO_2$), quartz and cristobalite, was totally altered during service in regions close to the hot face. At room temperature the altered microstructure consisted of corundum and gehlenite in a new oxide glass phase containing the elements Na, K, Ca, Fe, Ti, Al, Ni, and Si. The reactions of the fuel oil impurities Na, Fe, and Ni with mullite, quartz, and cristobalite in the original castable refractory caused the rapid degradation at the hot face during service in the boiler. Increasing the Al_2O_3 content of the castable by replacing mullite aggregate with alumina aggregate and using gehlenite with less iron impurity as the bonding material should improve the performance of this castable refractory or retard reactions of the castable with fuel oil combustion products including Na, Fe, and Ni.

55748 **Low Btu gas horizontal burner.** McCartney, M.S. (to Combustion Engineering, Inc.). US Patent 4,095,929. 20 Jun 1978. Filed date 14 Mar 1977. 4p.

An apparatus is described for burning a product gas having a low BTU content wherein a single burner is adapted to burn the low energy gas alone with the turndown capability of a multi-burner arrangement. The gas flow is separated into two independent flow streams with one flow stream being exhausted into a primary air stream and the other into a secondary air stream prior to combustion. A common control means responsive to changes in load is provided to modulate the secondary air stream and its associated gas stream whereby at decreasing loads proportionately increased amounts of air and gas are directed through the primary air and gas streams.

55749 **Reduction of nitric oxide emission in oil furnaces.** Buzina, M.; Petro, E.; Janssen, H.J. *Brennst.-Waerme-Kraft;* **30**: No. 6, 255-257(Jun 1978). (In German).

The influence of the flue gas return into the combustion chamber on the formation of NOsub(x) is discussed. Several variants prove the strong influence of the combustion equipment and the kind of mixing air and flue gas. The testing equipment, the test variants and the results of the measurements are described.

UNDERGROUND ENGINEERING

REFER ALSO TO CITATION(S) 54418

55750 **Basic trends in the activity of MAKNII (Makeevka Safety in Mines Research Institute).** Timoshenko, A.T. *Przegl. Gorn.;* **33**: No. 11, 535-539(Nov 1977). (In Polish).

Work carried out from 1971 to 1975 and that planned for 1976 to 1980 is described.

55751 **Ventilation techniques developed in South Africa.** Cook, N.G.W. (Univ. of California, Berkeley). pp 16p, Set No. 8, Paper 1 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

There are many reasons why it is necessary to ventilate and cool underground mines. These include the need to supply oxygen, purge and dilute harmful gases, obviate explosive concentrations of flammable gases, reduce dust levels, provide a thermally acceptable environment and remove heat from the mine. In deep mines, the last two of the above items are so dominant that the ventilation required to meet them suffices for the others also. The gold mines in South Africa now work down to depths of more than 3.5 km below surface. The need for cooling and ventilation arises primarily from the effects of autocompression (the wet-bulb temperature of the ventilation air increases at the rate of about 4°C per kilometer of depth) and, secondarily, from the virgin rock temperatures, which approach 60°C. A total of some 750 million tons of atmospheric air is circulated through all 40-odd gold mines each year and the total installed refrigeration capacity is about 250 MW. Field and laboratory investigations and engineering theory have led to the concept of Specific Air Cooling Power as the most meaningful measure of environmental heat stress. The Specific Air Cooling Power is a measure of the rate at which heat can be dissipated to the ventilation from the human body by evaporation in warm, humid conditions. It depends mainly on the wet-bulb temperature and velocity of the ventilation air. Service water used in mining is now being chilled to improve the effectiveness with which refrigeration can be used to keep working places cool. Numerical codes have been developed for simulating the flow of ventilation air through complex mine workings and for estimating the heat flux into the ventilation and changes in air temperatures. These codes facilitate greatly the planning and control of ventilation and cooling systems.

MARINE ENGINEERING

REFER ALSO TO CITATION(S) 54529, 54540

55752 **Two degree of freedom model for the dynamics of offshore structures.** Taylor, R.E. (University Coll., London). *Int. J. Earthquake Eng. Struct. Dyn.;* 6: No. 4, 331-346(1978).

As a means towards an understanding of the structural dynamics of deepwater gravity platforms, the dynamic response of a linear two degree of freedom spring—mass—damper system is studied herein. The mathematical model represents dynamic interaction between structure and foundation. Particular attention is paid to the influence of wave force distribution. Transfer functions are obtained for the response to sinusoidal waves, and resonant magnification factors are plotted for a range of structural and loading parameters. It is concluded that the response even of this simple idealization is far from straightforward.

55753 **Subsurface transportation of long marine pipelines.** Kan, W.C. Austin, TX; Univ. of Texas (1977). 175p. University Microfilms Order No. 78-07,328.

Thesis (Ph. D.).

The major contribution of this work is the development of techniques necessary for the study of static, dynamic and random stress characteristics of a long marine pipleline system being transported under the sea surface to a connection site. This method of offshore construction offers substantial cost savings where deep water oil and gas wells are concerned.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 54951, 54952, 55749, 55874

55754 **Apparatus for ionizing gases, electrostatically charging particles, and electrostatically charging particles or ionizing gases for removing contaminants from gas streams.** Schwab, J.J.; Goodson,

D.B. (to Air Pollution Systems, Inc.). US Patent 4,093,430. 6 Jun 1978. Filed date 28 May 1976. 14p.

A venturi increases the velocity of contaminated gases and guides the gases past a high, extremely dense electrostatic field presented perpendicular to the gas flow and extending radially outward between a central, accurately sized disc electrode and the surface of the venturi throat. Downstream, charged particles are collected by a wet scrubbing process or electrostatic precipitator.

55755 (NTIS/PS—78/0254) **Gas scrubbers used in pollution control. Volume 2. 1976-March 1978 (citations from the NTIS data base). Report for 1976-mar 78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 187p.

The bibliography cites Federally-funded research describing processes and equipment used in the removal of SO_2, NO/ sub x/, CO, CO_2, organic compounds and particulates. Design, performance, chemistry, and some of the gas flow characteristics for both stationary as well as mobile sources are included. (This updated bibliography contains 181 abstracts, 93 of which are new entries to the previous edition.)

55756 (NTIS/PS—78/0255) **Gas scrubbers used in pollution control. Volume 3. 1976 (citations from the Engineering Index Data base). Report for 1976.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 139p.

The bibliography contains worldwide citations on particle and gas scrubbers. They discuss the pollution control of SO_2, NO/ sub x/, CO, CO_2, as well as hydrocarbons and particles. Design, performance, gas flow characteristics, and the chemistry of the pollutants are included. (This updated bibliography contains 132 abstracts, none of which are new entries to the previous edition.)

55757 (NTIS/PS—78/0256) **Gas scrubbers used in pollution control. Volume 4. 1977-March 1978 (citations from the Engineering Index Data base). Report for 1977-Mar 78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 155p.

These worldwide reports pertain to particle and gas scrubbers. The citations include design, performance, gas flow characteristics, and the chemistry of the pollutants. They discuss the pollution control of SO_2, NO/ sub x/, CO, CO_2, as well as hydrocarbons and particles. (This updated bibliography contains 148 abstracts, 142 of which are new entries to the previous edition.)

55758 (PB—276583) **Inertial cascade impactor substrate media for flue gas sampling. Final report, November 1976—Mar 1977.** Felix, L.G.; Clinard, G.I.; Lacey, G.E.; McCain, J.D. (Southern Research Inst., Birmingham, AL (USA)). Jun 1977. Contract EPA-68-02-2131. 92p. NTIS PC A05/MF A01.

The report summarizes Southern Research Institute's experience with greases and glass fiber filter material used as collection substrates in inertial cascade impactors. Available greases and glass fiber filter media have been tested to determine which are most suitable for flue gas sampling. Greases are probably not useful at above 177C. For higher temperatures, glass fiber filter material can be used. Of 19 greases tested by heating in the laboratory and by exposure to flue gas in the field, only Apiezon H grease performed satisfactorily at above 149C. In experiments to evaluate the use of filter materials as impactor substrates, mass increased as a result of exposure to flue gas for all of the fiber media tested. Laboratory and field studies are described which were directed toward developing a method to passivate glass fiber filter material to SOx induced mass gains. These studies indicate that a H_2SO_4 wash, followed by a thorough distilled water/isopropanol rinse, drying, and baking, augmented by in situ conditioning, offers the best hope for reducing SOx induced mass gains. Reeve Angel 934AH glass fiber filter material performed best among the media tested.

55759 Gas scrubbing method. Brooks, R.J.; Brooks, B. (to Chemithon Corp.). US Patent 4,096,236. 20 Jun 1978. Filed date 2 Dec 1976. 10p.

A scrubbing system including scrubbers having straight through or direct line gas flow, with steam pretreatment of the gases supplied to the scrubber is described. The scrubbing solution may be recycled. Where steam is present in the process, the effluent gas is partially recycled to the process upstream of the scrubber to maintain a predetermined level of steam moisture in the gases entering the scrubber.

55760 Method for manufacture of catalyst used for reduction of nitrogen oxides. Nishikawa, Y.; Watanabe, A.; Sugimoto, T.; Mizuta, Y.; Hatayama, Y. (to Kyushu Refractories Co., Ltd.). US Patent 4,096,096. 20 Jun 1978. Priority date 21 Aug 1975, Japan. 8p.

An excellent catalyst for the reduction of nitrogen oxides is obtained by mixing a specific aluminum-containing substance with a specific iron-containing substance in water and baking the resultant precipitate.

55761 Rapping assembly and electrode supports for electrostatic precipitators. Frauenfelder, A. (to American Air Filter Co., Inc.). US Patent 4,093,431. 6 Jun 1978. Filed date 13 Dec 1976. 6p.

A device is disclosed for rapping electrode carriers and supporting same within an electrostatic precipitator whereby dust accumulating upon electrodes extending vertically from the electrode carriers is removed. The rapping assembly and electrode support means are suspended from the roof of an electrostatic precipitator wherein the electrode support means includes a rapping shaft drive means at the lower end thereof and electrode carrier means. The rapping shaft drive means is in driving relation with a rapping shaft wherein the rapping shaft rotates at a preselected rate and includes a plurality of rapping members attached thereto, each rapping member being disposed to rap each electrode carrier which in turn sends vibrations through the electrodes which extend vertically downwardly from the electrode carriers thereby removing dust accumulating on the electrodes.

55762 Electrostatic precipitator. Ahlrich, W.K. US Patent 4,093,432. 6 Jun 1978. Filed date 3 Sep 1976. 12p.

An electrostatic precipitator is described that has a rotor supported for rotation within a housing containing inlet and outlet openings adjacent the opposite ends. The rotor is formed by a plurality of ringlike collector plates which are fixedly connected in axially spaced relationship. One end of the rotor, as disposed adjacent the outlet opening, is closed by a support plate. The collector plates are alternately of opposite charge to create electrostatic fields therebetween. The collector plates have aligned central openings which decrease in diameter towards the closed end of the rotor. The plates also have equal surface areas so that substantially equal electrostatic fields are created between each adjacent pair of plates. The collector plates, in the radially outward direction, are sloped in a direction which is axially opposite to the direction of the gas supplied to the inlet opening. An ionizing device is disposed across the inlet opening to the rotor for ionizing the foreign particles entrained in the gas. The ionizing device includes a plurality of ionizing wires disposed perpendicular to the rotational axis of the rotor, which wires are uniformly spaced between grounded flow divider bars which also extend perpendicularly of the inlet opening.

55763 Elimination of gaseous substances from hot flue gases by dry processes. Rasch, R. *Aufbereit.-Tech.;* **19**: No. 4, 156-162(Apr 1978). (In German).

Dry, hot cleaning of waste gases prevents cold, steam-saturated waste gases which, in turn, imply sewage and sludge problems. Absorptive, chemical bonding of gas components to suitable powdery solids requires the ranges of chemical bonding to be maintained and high dust concentrations to be ensured. Although dry hot cleaning of waste gases is, to a certain extent, still in a developing stage it has become practically applicable for extremely high loads. The paper gives a summarized report of the achievements realized so far.

55764 Determinant factors in the choice of dust removal equipment. Muhlrad, W. *Rev. Gen. Therm.;* **17**: No. 195, 211-220(Mar 1978). (In French).

The specific information required for evaluating and selecting dust removal equipment is listed. The dusts to be handled are characterized by their chemical composition, specific gravity, and granulometric composition. The shape and surface area, their concentration and origin also have important effects on the efficiency of a separator. The gas in which the dust is suspended is characterized by its flow, temperature and chemical composition (the presence of water is important). It is shown that the removal and reuse of the trapped dust should be considered, finally, the applicable legislation should be considered.

PARTICLE ACCELERATORS

REFER ALSO TO CITATION(S) 56296

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 56299

55765 Synchrotron orbital radiation and its utilization. Ooba, N.; Yao, T.; Nishihara, Y.; Hirano, M.; Ihara, H. (Electrotechnical Lab., Tanashi, Tokyo (Japan). Tanashi Branch). *Denshi Gijutsu Soso Kenkyusho Chosa Hokoku;* No. 191, 1-298(Dec 1976). (In Japanese).

Synchrotron orbital radiation (SOR) is now widely used as a continuous source of vacuum ultraviolet and soft X-ray radiation. The following topics are discussed: the electron storage ring as a

radiation source and various fields of the utilization of SOR together with the surrounding research and technical problems; the characteristics of SOR and the utilization of SOR in various fields. The theory of the electron storage ring and the design principles the various parts of the storage ring. The design calculation and the parameters of the proposed 600 MeV machine; the design considerations of the vacuum system of the electron storage ring; the vacuum monochromators to be used with SOR, mainly those of a grazing incidence type; the electron beam and X-ray lithography, especially the utilization of SOR for the soft X-ray lithograpyy; the necessity of the extreme ultraviolet radiometric standard to spectroscopic research of plasma; the accurate measurement of soft X-ray radiation due to heavy ion impurities in plasma; the utilization of SOR as the standard of spectral emission in ultraviolet and vacuum ultraviolet regions, and the detector standards in these wavelength regions; the fundamental problems of soft X-ray measurement; the photoelectron spectroscopy of solids, its application to refractory materials and to semiconductors, the problems of semiconductor surfaceanalysis, and its application to alkali halide mainly in the vacuum ultraviolet region; the absorption spectra of atoms in the vacuum ultraviolet region; the utilization of SOR for research studies on molecules; and thehe absorption spectra of metals and semiconductors in the vacuum ultraviolet and soft X-ray region.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

55766 (BNL—23749) **Heat transfer in the vacuum chamber wall.** Krinsky, S. (Brookhaven National Lab., Upton, NY (USA)). [nd]. Contract EY-76-C-02-0016. 18p. Dep. NTIS, MF A01.

Portions of document are illegible.

Some heat transfer problems associated with the incidence of synchrotron radiation upon the inner wall of the vacuum chamber are considered. It is assumed that power is supplied to the wall at P watts per azimuthal centimeter, so when the ribbon of radiation has a vertical height d, the incident power per unit area is P/d. Our goal is to determine the maximum temperature to be found on the inner surface of the chamber wall, when the wall has thickness L, and the outer surface of the wall is maintained at temperature T/sub W/ by water cooling. An idealizd two-dimensional potential problem is studied, where the two-dimensional cross-section is taken perpendicular to the electron beam.

55767 **Radiation of relativistic electrons in a variable ondulator.** Nikitin, M.M.; Fedosov, N.I. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). *Izv. Vyssh. Uchebn. Zaved., Fiz.;* No. 6, 48-51(Jun 1977). (In Russian).

The polarization and spectral-angular characteristics of radiation of an electron were investigated in an arbitrary system of constant ondulators with differing magnetic field strengths, distribution, period and numbers of periods. It is shown that the radiation in a variable ondulator has the same polarization properties as the synchrotron radiation. However, the spectral-angular characteristics may differ considerably both from the synchrotron radiation spectrum and the ondulating radiation spectrum in a constant ondulator. It is shown that an arbitrary system of constant ondulators can produce an arbitrary radiation spectrum in broad range of wavelengths.

55768 **Optimization of photon-electron interaction for Compton scattering of laser radiation on relativistic electron ring.** Glejzer, S.M.; Nechaev, B.A.; Peshkov, A.V. (Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). *Izv. Vyssh. Uchebn. Zaved., Fiz.;* No. 1, 150-152(1977). (In Russian).

55769 **Theory of ion resonance acceleration in high-current relativistic beams.** Indykul, V.P.; Panchenko, I.P.; Shapiro, V.D.; Shevchenko, V.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). *Fiz. Plazmy;* 2: No. 5, 775-788(Sep 1976). (In Russian).

The theory of a resonance method of ion acceleration by a negative energy wave propagating in a magnetized electron beam is developed. The linear theory of instability causing ion acceleration is considered. Partial simulation method is employed to investigate the instability nonlinear dynamics. It is shown that the energy of accelerated ions increases linearly with a coordinate at sufficiently large distances when the major portion of ions is trapped in the synchronous bunches. The stabilization mechanism of the instability appearing when the electron beam is non resonance with the wave, is discussed and the maximum power transferred to the ion component is calculated.

55770 **Technique for pulsed magnetic field formation.** Lukonin, E.I.; Semenov, V.D.; Furman, Eh.G. (to Tomskij Politekhnicheskij Inst. (USSR). Inst. Yadernoj Fiziki, Ehlektroniki i Avtomatiki). USSR Patent 510,816/A/. 15 Apr 1976. Filed date 5 Jul 1974. 3p. (In Russian).

The invention relates to acceleration engineering and is aimed at exciting electromagnets of power accelerators of the synchrotron or betatron types. The proposed circuit connection of separate units of electromagnets, storage capacitors, commutating elements, and power supplies makes it possible to: (1) obtain triangular magnetic fields in the proposed device when a high pulse repetition rate is required; (2) form a magnetic field pulse of sinusoidal shape with a flat top; and (3) program the pulse repetition rate.

AUXILIARIES AND COMPONENTS

55771 (UCRL—80853) **Off-resonance transformer charging for 250-kV water Blumlein.** Cook, E.; Reginato, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jun 1978. Contract W-7405-ENG-48. 8p. (CONF-780676—3). Dep. NTIS, PC A02/MF A01.

From 13. pulse power modulator symposium; Buffalo, NY, USA (20 Jun 1978).

An off-resonance transformer for charging a 250-kV Blumlein system provides a viable alternative to other charging schemes by permitting the use of conventional thyratrons. Such a transformer must have reliability, a reasonable voltage step-up, and a nonreversing primary current. The analysis, design, and performance data for such a transformer are presented. The strong interrelationship between transformer design and Blumlein requirements necessitates that Blumlein description and design criterion be briefly presented prior to transformer design such that transformer load requirements be defined.

INJECTION AND EXTRACTION SYSTEMS

55772 **Device for the magnetic correction of the trajectories of a beam of accelerated particles emerging from a cyclotron.** Kervizic, J.; Hurt, B. (to C.G.R. MeV). US Patent 4,095,201. 13 Jun 1978. Priority date 8 Aug 1975, France. 4p.

A magnetic correction device is described for locally modifying the strength of the magnetic field of a cylcotron in the zone of extraction of the accelerated particles to promote the extraction function and to ensure a suitable focusing of the emergent beam. In one embodiment, the device comprises a block of prismatic shape made of a composite laminated material formed by a stack of plates P_1 and P_2 of different permeabilities. The plates P_1 are for example made of cobalt steel and those P_2 of non-magnetic material (copper for example).

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 56157

55773 (BNL-NCS—50681, pp 175-184) **Fluence mapping of RTNS-I by helium accumulation and foil activation methods.** Farrar, H. IV (Atomics International Div., Canoga Park, CA); Kneff, D.W.; Britten, R.A.; Heinrich, R.R. Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The need to know the neutron fluence variation precisely over the volume of an experiment in the d-T neutron environment of the Rotating Target Neutron Source (RTNS-I) at LLL led to the design of significantly more detailed dosimetry procedures for that experiment. The experiment was conducted as part of a program to determine helium generation rates and spectrum-integrated (n,α) cross sections. The neutron dosimetry in the experiment included the mapping of fluence information from both segmented radiometric foils and helium accumulation fluence dosimetry materials. The results provided the most detailed information yet obtained for the innermost fluence variation of the RTNS-I neutron field, and demonstrated the application of helium accumulation fluence dosimetry to high-energy-neutron fields as a valuable tool complementary to radiometric foils. The procedures can be used to characterize future d-T irradiations and can be extended to the more complex d-Be and d-Li neutron environments. Attenuation-corrected neutron fluence profiles and helium generation results are plotted. 4 figures. (RWR)

55774 (LA—7222-MS) **Muon spectra from pion production targets.** Tschalaer, C. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 32p. Dep. NTIS, PC A03/MF A01.

Calculations are presented of muon rates from pion production targets. Two muon production modes were considered: the cloud mode, in which positive and negative pions decay in flight near the production target; and the surface mode, in which positive pions stop in the target near its surface. Numerical calculations were

based on production data of 730-MeV protons in carbon, extrapolated to low energies assuming constant phase-space density. Muon fluxes, stopping densities, and polarizations were evaluated for the Low-Energy Pion (LEP) Channel at LAMPF and a new high-intensity muon beam proposed at SIN. Results compare favorably with measured rates of the best existing muon channels below muon momenta of 70 to 80 MeV/c.

INSTRUMENTATION

55775 Novel technique for dynamic surface tension and viscosity measurements at liquid—gas interfaces. Sohl, C.H.; Miyano, K.; Ketterson, J.B. (Department of Physics, Northwestern University, Evanston, Illinois 60201 and Argonne National Laboratory, Argonne, Illinois 60439). *Rev. Sci. Instrum.;* **49**: No. 10, 1464-1469(Oct 1978).

A novel means of generating and detecting surface waves at liquid—gas interfaces has been successfully developed. Electrocapillarity is used to generate the waves which are detected via specular reflection of a laser beam from the fluid surface to a position sensitive photodiode. Such a scheme is compact, sensitive, and does not mechanically touch the fluid surface. A preliminary study of highly damped waves on the magnetically oriented liquid crystal MBBA is reported.

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 55077, 55099, 55552, 55806

55776 (ORNL—5371) **Instrumentation requirements for radiological defense of the U.S. population in community shelters. Final report.** Haaland, C.M.; Gant, K.S. (Oak Ridge National Lab., TN (USA)). Aug 1978. Contract W-7405-ENG-16. 153p. Dep. NTIS, PC A08/MF A01.

Estimates are made of requirements for instruments for radiological defense of the U.S. population in the event of a nuclear attack. A detailed Community Shelter Plan posture is developed for each of 42,000 Standard Location Areas. Travel distance from residence to shelter in urban areas is limited to approximately 1 mile. Sixty percent of the U.S. population is sheltered in home basements, thirty-one percent in National Shelter Survey shelters, and nine percent is in neither. Three minimum allocations of instruments are developed. Allocation A, one radiological defense set per shelter, is essentially the same as the current civil defense allocations but is found to be inadequate for about 100,000 shelters having more than 100 occupants. Allocation B requires 3.4 million new dosimeters based on estimated shelter occupancy and provides a minimum instrumentation for radiological defense but not enough instruments to maintain individual dose records. Allocation C would require 18.1 million new dosimeters and would provide adequate instrumentation to maintain dose records for all shelter occupants.

55777 Nuclear reactor ex-core startup neutron detector. Wyvill, J.R. (to Combustion Engineering, Inc.). US Patent 4,090,083. 16 May 1978. Filed date 14 Oct 1976. 6p.

A scintillation type neutron detector is provided herein for the measurement of neutrons with optimum neutron sensitivity and minimum gamma sensitivity. A large diameter nuclear radiation insensitive photomultiplier tube is optically connected to a scintillating medium which is responsive to thermalized neutrons. The neutrons available for detection are thermalized by a neutron moderating material adjacent to the scintillator medium. Enclosing and shielding the photomultiplier, the scintillator medium, and the moderator is a combined lead and borated silicone resin housing.

55778 Radiameter. Lecuyer, P.L.D.; Crousillac, F. (to La Material Telephonique). US Patent 4,087,692. 2 May 1978. Filed date 11 Nov 1976. 6p.

Apparatus for measuring atomic radiation includes a plurality of solid-state detectors, typically connected in parallel, each detector being selected such that the parallel combination has a desired response characteristic. The detectors are connected to the input of a preamplifier/integrator which, in turn, drives a counter via a trigger circuit. The detectors, trigger circuit and preamplifier/integrator may advantageously be combined on a single integrated circuit chip.

55779 Radioactive well logging to measure earth formation fluid permeability by electrohydraulic induced flow of radiation activated fluids. Arnold, D.M.; Dowling, D.J.; Warren, W.F. (to Texaco Inc.). US Patent 4,076,980. 28 Feb 1978. Filed date 26 Oct 1976. 12p.

Oxygen in a borehole fluid in the vicinity of a reference region, such as an earth formation of known fluid permeability, is activated with a logging instrument by being bombarded with neutrons of 14 MEV energy level to form the unstable isotope nitrogen 16 giving rise to gamma radiation. Flow of the activated fluid is then caused by an electrohydraulic flow generator which forms an intense pressure pulse in the fluid. A gamma ray detector in the logging instrument senses the amount of flow of the activated fluid within the borehole in the reference region. The logging instrument is then moved to a formation whose liquid permeability is to be tested. Borehole fluid opposite the formation to be tested is activated by neutron bombardment, again giving rise to gamma radiation, and fluid flow in the formation under test is caused by the electrohydraulic flow generator. The gamma ray detector reading of activated fluid flow in the borehole opposite the formation under test, when compared with the flow reading in the borehole opposite the reference region, is a measure of relative fluid permeability in the formation being tested.

55780 Device for measuring radiation absorption or emission. Meyer-Ebrecht, D.; Kowalski, G. (to U.S. Philips Corp.). US Patent 4,075,484. 21 Feb 1978. Priority date 15 Jul 1975, German, Federal Republic of (F.R. Germany). 8p.

A device for correcting measuring values of a group of radiation detectors for measuring the intensity or distribution of radiation, comprising an additional radiation source for direct irradiation of the detectors is described. The radiation of the said additional radiation source can be switched on each time when the radiation to be measured is not incident on the radiation detectors. The device furthermore comprises a calculating device which forms for each radiation detector the quotient of the measuring value (M1(x)) and the reference measuring value (M2(x)) of the radiation detectors when exposed to the radiation of the additional radiation source.

55781 Multiple masking imaging system. Tancrell, R.H.; Stoner, W.W.; Wilson, D.T. (to Raytheon Co.). US Patent 4,075,483. 21 Feb 1978. Filed date 12 Jul 1976. 22p.

An imaging system utilizing a scintillation camera for photographing subjects emitting gamma and x-radiation is described. Masks are sequentially positioned between the subject and the camera to produce a sequence of shadowgrams upon the face of the camera. Output signals of the camera are summed together to give an array of sum signals, the array of sum signals being Fourier transformed followed by a matched filtering by multiplication of the frequency terms by an array of factors utilized in generating the masks. Phase factors are applied to the camera output signals, either before the Fourier transformation or during the matched filtering, the phase factors identifying the masks utilized in producing the respective shadowgrams. An inverse Fourier transformation then results in an image of the subject.

55782 Scintillation camera for establishing the coordinates of a radiation stimuli produced by a radiation field. Zioni, J.; Klein, Y.; Inbar, D. (to Elscint, Ltd.). US Patent 4,060,730. 29 Nov 1977. Filed date 6 Sep 1974. 18p.

A scintillation camera has a planar scintillating crystal that produces light events whose spatial distribution corresponds to the spatial distribution of the radiation stimuli causing such events, and a plurality of photomultipliers having photocathodes for receiving light from the crystal through a planar face thereof. Computing circuitry coupled to the photomultipliers computes the projection of a light event in the crystal on a reference axis by forming an analytical function of the outputs of the photomultipliers according to the spatial location of the light event in the crystal.

55783 Method for manufacturing nuclear radiation detector with deep diffused junction. Hall, R.N. (to General Electric Co.). US Patent 4,060,432. 29 Nov 1977. Filed date 20 Oct 1975. 8p.

Germanium radiation detectors are manufactured by diffusing lithium into high purity p-type germanium. The diffusion is most readily accomplished from a lithium-lead-bismuth alloy at approximately 430°C and is monitored by a quartz half cell containing a standard composition of this alloy. Detectors having n-type cores may be constructed by converting high purity p-type germanium to n-type by a lithium diffusion and subsequently diffusing some of the lithium back out through the surface to create a deep p-n junction. Production of coaxial germanium detectors comprising deep p-n junctions by the lithium diffusion process is described.

55784 Gamma counter calibration system. Luitwieler, S.H.; Horrocks, D.L. (to Beckman Instruments, Inc.). US Patent 4,060,726. 29 Nov 1977. Filed date 18 Oct 1976. 12p.

A method and apparatus are described for the calibration of a gamma radiation measurement instrument to be used over any of a number of different absolute energy ranges. The method includes the steps of adjusting the overall signal gain associated with pulses which are derived from detected gamma rays, until the instrument is

calibrated for a particular absolute energy range; then storing parameter settings corresponding to the adjusted overall signal gain, and repeating the process for other desired absolute energy ranges. The stored settings can be subsequently retrieved and reapplied so that test measurements can be made using a selected one of the absolute energy ranges. Means are provided for adjusting the overall signal gain by varying the voltage supplied to a multiplier phototube included in the instrument, or by varying the gain of attenuators coupled to the output of the phototube. A specific technique is disclosed for making coarse, then fine adjustments to the signal gain, for rapid convergence on the required calibration settings.

55785 Coakial gamma ray detector and method therefor. Harchol, M. (to Princeton Gamma-Tech, Inc.). US Patent 4,056,726. 1 Nov 1977. Filed date 1 Oct 1975. 14p.

A coaxial gamma ray detector is fabricated using intrinsic Ge semiconductor material in a geometry whereby full depletion of electrical carriers is prevented within a small region proximate the point of electrical contact thereby allowing greater biasing potentials across the detector and, consequently, providing reduced electronic noise and increased energy resolution.

55786 Focus collimator press for a collimator for gamma ray cameras. York, R.N.; York, D.L. (to Precise Corp.). US Patent 4,056,427. 1 Nov 1977. Filed date 14 Jul 1976. 6p.

A focus collimator press for collimators for gamma ray cameras is described comprising a pivot arm of fixed length mounted on a travelling pivot which is movable in the plane of a spaced apart work table surface in a direction toward and away from the work table. A press plate is carried at the opposite end of the fixed length pivot arm, and is maintained in registration with the same portion of the work table for pressing engagement with each undulating radiation opaque strip as it is added to the top of a collimator stack in process by movement of the travelling pivot inward toward the work table. This enables the press plate to maintain its relative position above the collimator stack and at the same time the angle of the press plate changes, becoming less acute in relation to the work table as the travelling pivot motes inwardly toward the work table. The fixed length of the pivot arm is substantially equal to the focal point of the converging apertures formed by each pair of undulating strips stacked together. Thus, the focal point of each aperture row falls substantially on the axis of the travelling pivot, and since it moves in the plane of the work table surface the focal point of each aperture row is directed to lie in the same common plane. When one of two collimator stacks made in this way is rotated 180 degrees and the two bonded together along their respective first strips, all focal points of every aperture row lie on the central axis of the completed collimator.

55787 Focal-surface detector for heavy ions. Erskine, J.R.; Braid, T.H.; Stoltzfus, J.C. (to Dept. of Energy). US Patent Application 796,626. 13 May 1977. 18p.

A detector of the properties of individual charged particles in a beam includes a gridded ionization chamber, a cathode, a plurality of resistive-wire proportional counters, a plurality of anode sections, and means for controlling the composition and pressure of gas in the chamber. Signals generated in response to the passage of charged particles can be processed to identify the energy of the particles, their loss of energy per unit distance in an absorber, and their angle of incidence. In conjunction with a magnetic spectrograph, the signals can be used to identify particles and their state of charge. The detector is especially useful for analyzing beams of heavy ions, defined as ions of atomic mass greater than 10 atomic mass units.

RADIATION DOSEMETERS

REFER ALSO TO CITATION(S) 55776

55788 (BNWL-SA—6503) Review of unfolding methods used in the U.S. and their standardization for dosimetry. Oster, C.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). [nd]. Contract EY-76-C-06-1830. 20p. (CONF-771036—17). Dep. NTIS, PC A02/MF A01.

From 2. ASTM-EURATOM symposium on reactor dosimetry) dosimetry methods for fuels, cladding and structural materials; Palo Alto, CA, USA (2 Oct 1977).

A summary of the methods used in the U.S. to unfold radiation spectra is given. For discussion purposes, the methods studied are placed in groups, based on the algorithm used for unfolding and/or treatment of data uncertainties. Specific codes from each group are selected and examined for their role in dosimetry standardization. Finally, the preparation of the ASTM recommended practices and use of benchmark problems in the standardization process are discussed. 69 references.

55789 Utilization of the $^{16}O(n,p)$ reaction for monitoring the output of 14 MeV neutron generators. Buchanan, R.J.; Beach, J.L. (Department of Radiation Biophysics, University of Kansas, Lawrence, Kansas 66045). *Med. Phys.;* 5: No. 5, 387-390(Sep 1978).

A system based upon the $^{16}O(n,p)^{16}N$ reaction has been developed for monitoring 14-MeV neutron production. The system has proven to be quite applicable for monitoring the output of a disk-shaped neutron source and computer analysis has shown it equally suitable for monitoring the ouput of cone-shaped neutron sources from gas targets presently being considered for cancer therapy.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 55787

55790 (LBL—7940) Experiment definition and integration study for the accommodation of magnetic spectrometer payload on spacelab/shuttle missions. Final report, June 13, 1977—July 1, 1978. Space Sciences Laboratory Series 19, Issue 45. Buffington, A. (California Univ., Berkeley (USA). Space Sciences Lab.). 27 Jun 1978. Contract W-7405-ENG-48. 58p. Dep. NTIS, PC A04/MF A01.

A version of the High Energy Astronomical Observatory (HEAO) magnetic spectrometer which is updated for the space shuttle sortie mode is described. A stripped-down experiment is considered with a magnetic spectrometer alone, even though any real space shuttle magnetic spectrometer experiment would almost certainly include other detectors. Problems relating specifically to superconducting magnetic spectrometers are studied. In particular, almost all of the support provided for this contract was spent in investigating new cryostat parameters appropriate to the shuttle weight and duration constraints. It was found that the size and weight of the cryostat, for a two-month lifetime, can be substantially reduced from that contemplated for HEAO. Moreover, with the reduced documentation requirements contemplated for the space shuttle, a considerable cost savings relative to HEAO can be realized. Since a superconducting magnetic spectrometer has considerable magnetic fringe field, methods for shielding sensitive electronic and mechanical components of other experiments, or the space shuttle itself, from the effects of the field, are considered. Experiments placed further away than the immediately neighboring pallet will see a magnetic field only slightly greater than the Earth's. Since even the neighboring pallet's components see a field of less than 100 gauss, magnetic shielding can be accomplished for practically all sensitive locations by passive, high-permeability shields. (WHK)

RADIOMETRIC INSTRUMENTS

55791 Ion detector. Depoitier, J.; Vinchent, R. (to Institut National des Radio-elements-Nationaal Instituut vor Radio-elementen en abrege). US Patent 4,082,952. 4 Apr 1978. Priority date 11 Jul 1975, Belgium. 6p.

Axially aligned conductive metal cylindrical members on opposite sides of a printed circuit plate define a first measuring chamber and a second reference chamber on opposite sides thereof. The bottom of one cylindrical member forms the first electrode of the reference chamber and a plate closing off the end of the measuring chamber remote from the printed circuit plate forms the first electrode of the measuring chamber. Radioactive sources are mounted to the first electrode of respective chambers and a rod projects through the printed circuit plate coaxial with the first and second cylindrical members and terminates short of the plate closing off the first chamber and the bottom of the second chamber cylindrical member, the second electrodes for the chambers mounted respectively at the ends of the rod, and wherein the second electrode of the first chamber comprises a flat apertured portion in parallel with the plate overlying the end of the first cylindrical member remote from the printed circuit plate with the first cylindrical member plate defining a flat surface. The detector can be used in fire alarms. 7 claims, 4 figures.

55792 Ionization detectors. Lorch, E.A.; Dwight, D.J. (to Radiochemical Centre Ltd.). US Patent 4,051,376. 27 Sep 1977. Priority date 28 Jan 1975, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A novel form of ionization detector, particularly one operating in the electron capture mode, is described. The detector includes iron-55 as a source of electrons to cause ionization. The detector may be operated in direct current, pulse or frequency modulated modes.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

55793 (AD-A—050112) Stored charge release in cables in low fluence x-ray environments. Topical report Jan—Apr 77. Clement, D.M.; Sheppard, T.J.; Nielsen, L.C.; Wuller, C.E. (TRW Defense

and Space Systems Group, Redondo Beach, CA (USA)). 8 Apr 1977. Contract DNA001-77-C-0084. 40p. NTIS PC A03/MF A01.

Stored charge release in cables exposed to low fluence X-radiation has been investigated in the SPI-6000 X-ray simulator. No anomalous response in vacuum has been observed in all cable samples except semirigid cables. However, even for semirigid cables this anomalous behavior disappears if the cable is not bent.

55794 (AD-A—050476) **Radiation characterization of sequential logic circuits. Final report.** Knoll, M.G.; Bobo, K. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Jan 1978. 51p. (AFWL-TR—77-167). NTIS PC A04/MF A01.

This report describes the test techniques for radiation characterizing medium and large-scale integration (MSI/LSI) sequential logic circuits where few internal nodes are available for testing. Four sequential logic devices, two transistor-transistor-logic (TTL) technology devices and two complementary-metal-oxide-silicon (CMOS) technology devices were characterized. The devices were characterized for gamma dose-rate logic upset, total gamma dose survivability, and neutron fluence survivability. The data has been analyzed to determine the applicability of the testing techniques and procedures.

55795 (AD-A—050845) **Extending and interfacing the MSEP semiconductor damage data bank for analysis and retrieval by DAMTRAC. Technical report.** Ruzic, C.P. (Harry Diamond Labs., Washington, DC (USA)). Dec 1977. 105p. (HDL-TR—1821). NTIS PC A06/MF A01.

Presented are four groups of programs to update, maintain, and list the diode and transistor data bases for use with circuit analysis codes. The data bases are specifically designed to work with the DAMTRAC code, but can work with other circuit analysis codes, too. Included in the data bases are the standard TRAC parameters, references to the sources of these parameters, and damage parameters with individual source references.

55796 (NTIS/PS—78/0225) **Transister amplifiers (a bibliography with abstracts). Report for 1964-Feb 78.** Reed, W.E. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 269p. NTIS PC N01/MF N01.

The design, development, and applications of transistor amplifiers are covered in the cited reports. Research on reliability and radiation effects is included. (This updated bibliography contains 264 abstracts, 76 of which are new entries to the previous edition.)

55797 **High reliability EPI-base radiation hardened power transistor.** Clark, L.E.; Saltich, J.L. (to Motorola, Inc.). US Patent 4,086,610. 25 Apr 1978. Filed date 28 Jun 1974. 8p.

A high-voltage power transistor is described which is able to withstand fluences as high as 3×10^{14} neutrons per square centimeter and still be able to operate satisfactorily. The collector may be made essentially half as thick and twice as heavily doped as normally and its base is made in two regions which together are essentially four times as thick as the normal power transistor base region. The base region has a heavily doped upper region and a lower region intermediate the upper heavily doped region and the collector. The doping in the intermediate region is as close to intrinsic as possible, in any event less than about 3×10^{15} impurities per cubic centimeter. The second base region has small width in comparison to the first base region, the ratio of the first to the second being at least about 5 to 1. The base region having the upper heavily doped region and the intermediate or lower low doped region contributes to the higher breakdown voltage which the transistor is able to withstand. The high doping of the collector region essentially lowers that portion of the breakdown voltage achieved by the collector region. Accordingly, it is necessary to transfer certain of this breakdown capability to the base region and this is achieved by using the upper region of heavily doped and an intermediate or lower region of low doping.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 54459, 54468, 55080, 55121

55798 (DOE/EV—0007) **Multiple controllers in a CAMAC crate.** (National Instrumentation Methods Committee (USA); European Standards on Nuclear Electronics (ESONE) Committee of European Labs.). Mar 1978. 35p. Dep. NTIS, PC A03/MF A01.

Provision for the use of auxiliary controllers in a CAMAC crate is made to extend the capabilities and fields of application of the CAMAC modular instrumentation and interface system of IEEE Standard 583-1975 (EUR 4100e). The ESONE document corresponding to this report document is EUR 6500e. Auxiliary controllers, located in several crates on a CAMAC Command Highway (Parallel Branch or Serial), can provide the user with an extremely effective distributed processing capability. This capability is useful in both data acquisition and automatic control systems where parallel processing is desirable. Auxiliary controllers can be of various degrees of sophistication, and some may include processor elements for increased autonomy from central computers. A further extension of the AC-based CAMAC system may include a special communication channel direct from an AC to another element in the system. High-speed block transfer of data can be effected to and from the AC in such a case. To permit use of the auxiliary controllers in CAMAC crates, the hardware and protocol are defined so as to: (1) provide means for granting control of the Dataway to auxiliary controllers that request control and to provide a priority selection scheme to arbitrate in the case of simultaneous requests from multiple controllers; and (2) provide means for the auxiliary controller to address (a) the dedicated module address lines and (b) the dedicated interrupt request LAM (Look-at-Me) lines, all of which terminate only at the crate controller station and at the module stations to which they are dedicated.

55799 (DOE/EV—0016) **Subroutines for CAMAC.** (National Instrumentation Methods Committee (USA); European Standards on Nuclear Electronics (ESONE) Committee of European Labs.). Jun 1978. 38p. Dep. NTIS, PC A03/MF A01.

A recommended set of software subroutines prepared by the Software Working Group of the U.S. Department of Energy NIM Committee and the ESONE Committee of European Laboratories for use with the CAMAC modular instrumentation and interface system of IEEE Standard 583-1975 (EUR 4100e) is presented. These subroutines provide a general capability for communicating with CAMAC systems. They will be of primary interest to those who wish to write their own data-processing programs in a high-level programming language, such as Fortran. The achievable data transfer rate is, of course, dependent on a number of factors, including the language used, the operating system, the compiler, the method and level of subroutine implementation and the computer.

55800 (SAND—78-0086C) **Rotated X-cut quartz resonators for high temperature applications.** EerNisse, E.P. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 5p. (CONF-780596—1). Dep. NTIS, MF A01.

From 32. frequency control symposium; Atlantic City, NJ, USA (31 May 1978).

Portions of document are illegible.

Several motivations for quartz resonator operation at temperatures as high as 300°C have appeared recently. Effective well logging in deep natural gas and oil wells and in geothermal resource wells requires pressure measurements to assess reservoir size by standard blow-off techniques. High resolution of the order of $1/10^6$ in the pressure measurements before and after blow-off allows reduction in the amount of blow-off used and thus minimizes loss of reservoir contents. Such high resolutions have been obtained to date only with quartz resonator pressure gauges, which utilize the sensitivity of quartz resonator frequency to initial stress as a transducer action (for example, the force-frequency effect or the stress effect). Unfortunately, present high-resolution, quartz-resonator pressure measurement devices operate only at temperatures below 100°C. Fuel economy improvement and electronic engine control, particularly for turbine engines, requires high resolution pressure and flow measurements in temperature environments potentially as extreme as in well logging. The rotated X-cut thickness shear quartz resonator has been characterized for potential use as a transducer in high temperature environments. The frequency-temperature characteristics are measured and shown to be useful between -50°C and 300°C with reasonably small frequency shifts over that temperature range and small curvature at the turning point. The force-frequency and stress coefficients are measured at 25°C and found to be suitable for transducer applications.

55801 (SAND—78-1108C) **Progress in the development of explosives materials detectors.** Williams, W.D.; Conrad, F.J.; Sandlin, L.L.; Burrows, T.A. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 7p. (CONF-780606—7). Dep. NTIS, PC A02/MF A01.

From Institute of Nuclear Materials Management meeting; Cincinnati, OH, USA (27 Jun 1978).

Five hand-held explosives vapor detectors (Elscint Model EXD-2, ITI Model 70, Leigh-Marsland Model S-201, Pye Dynamics Model PD.2.A, and Xonics Model GC-710) were evaluated for sensitivity to a variety of explosives, identification of false alarm agents, and general performance and maintenance characteristics. The results of this evaluation, as presented, indicate that there is no single explosives detector which is best-suited for use at all nuclear facilities. Rather, there are several site-specific elements which must be considered when choosing an explosives detector. There are several new explosives detector technologies being developed which will out-perform existing commercial equipment. Some of these new detectors may be commercially available by the end of fiscal year 1980 and will be cost-effective to purchase and operate. The following areas of explosives detection research are discussed: nitrogen-phosphorous detectors, plasma chromatography, mass spectroscopy, small animal olfactory, vapor preconcentration, nuclear quadrupole

resonance, far infrared radiation imaging, nuclear magnetic resonance, thermal neutron activation, and computerized tomography.

55802 (UCRL—52477) **High-temperature viscometer for use at 100 kPa.** Weed, H.C.; Dibley, L.; Piwinskii, A.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 May 1978. Contract W-7405-ENG-48. 14p. Dep. NTIS, PC A02/MF A01.

The design of a high-temperature rotational cup viscometer for measuring the viscosity of naturally occuring silicate melts for use at 100 kPa. We include design criteria, a description of the apparatus, and the results of calibration against both a standard oil and a National Bureau of Standards glass to 1322°K.

55803 Factors affecting high resolution fixed-beam transmission electron microscopy. Chiu, W.; Glaeser, R.M. (Univ. of California, Berkeley). *Ultramicroscopy;* 2: 207-217(1977).

An experimental and theoretical characterization of a fixed-beam transmission electron microscope with a field emission gun has been made with regard to the factors of electron beam brightness, spatial and temporal coherence of the incident electrons, objective lens current fluctuation, mechanical stability, and specimen contamination. It has been found that mechanical stability and temporal coherence are the primary factors that prevent the contrast transfer function from extending to 2.0 A in our microscope. Different amorphous thin films have also been used in order to compare their suitability for testing the imaging capability of the microscope at atomic resolution. 37 references.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 55800

55804 Spherical focusing method and apparatus for determining the thickness of a zone in an earth formation traversed by a borehole. Suau, J. (to Schlumberger Technology Corp.). US Patent 4,087,740. 2 May 1978. Filed date 6 May 1975. 12p.

An electrical well logging apparatus of the spherically focusing type is utilized to determine the diameter of a borehole drilled into a formation or the thickness of the mudcake on the borehole wall.

55805 Downhole geoelectric remote sensing method. Mufti, I.R. (to Standard Oil Co.). US Patent 4,087,741. 2 May 1978. Filed date 24 Aug 1976. 10p.

A simple geoelectric remote sensing cable comprising a single current electrode and a relatively large number of sensing, or potential, electrodes is described. The current electrode is at the center of the logging cable and the sensing electrodes are arranged symmetrically about the current electrode in such a manner that the spacing between adjacent sensing electrodes increases with distance from the current electrode. In the preferred embodiment, the sensing electrode spacings are all integral multiples of a basic interval unit, such as two and one-half feet. The cable is pulled from the bottom of a borehole to the top at a fixed rate while a fixed current is supplied to the current electrode and the voltage differences between each adjacent pair of sensing electrodes are recorded after each movement of a distance equal to the basic interval or an integral fraction thereof. In the preferred embodiment, a four-point electrode type of resistivity calculations is then made using the recorded data and the superposition prinicple.

55806 Calibrator for radioactivity well logging tools. Turcotte, R.E.; Hunt-Grubbe, R.H. (to Schlumberger Technology Corp.). US Patent 4,085,323. 18 Apr 1978. Filed date 28 Oct 1976. 6p.

A radioactivity logging tool including a gamma ray detector is field calibrated with the help of a sleeve that has a radioactive material distributed therein and is clamped about the tool so as to completely surround the detector. The radioactive material is preferably uranium 238. It can be either distributed uniformly inside the sleeve or take the form of wires which extend along generatrices or circumferences of the sleeve.

55807 Acoustic well logging with threshold adjustment. Vivet, B.; Trouiller, J.C.; Gruel, H. (to Schlumberger Technology Corp.). US Patent 4,040,001. 2 Aug 1977. Priority date 19 Jan 1972, France. 10p.

Acoustic well-logging methods and apparatus are provided for investigating earth formations traversed by a borehole. Acoustic waves is transmitted from different points in the borehole and received at other points in the borehole, and a reception signal is generated representative of the received acoustic waves. The time interval between the instant the measurement waves is transmitted and the instant the instantaneous amplitude of the reception signal exceeds a given detection threshold for the first time is measured as a function of depth and the value of the detection threshold is adjusted during each measurement sequence in accordance with the amplitude of the noise received during the next preceding listening interval.

EXPLOSIONS AND EXPLOSIVES

REFER ALSO TO CITATION(S) 55956

CHEMICAL

REFER ALSO TO CITATION(S) 55933, 55934, 55944

55808 (SAND—78-8628) **Experimental determination of the equation of state of explosives and pyrotechnics used in explosive actuators.** Ng, R. (Sandia Labs., Livermore, CA (USA)). Jun 1978. Contract EY-76-C-04-0789. 21p. (CONF-780706—13). Dep. NTIS, PC A02/MF A01.

From 6. pyrotechnics seminar; Estes Park, CO, USA (17 Jul 1978).

An experimental explosive chamber has been designed and used for the measurement of the pressure output history of explosives and pyrotechnics in explosive actuators. The design incorporates a variable volume concept, thus enabling the simulation of the pressure-volume history of an actuator as it is used in an actual explosive valve. A pressure transducer measures the dynamic pressure while a Velocity Interferometer System for Any Reflector (VISAR) is used at a sensitivity of 0.021 mm/μsec per fringe to measure the velocity of a moving actuator assembly. The simultaneous pressure and velocity data are used to calculate the pressure-volume equation of state for each explosive and pyrotechnic tested.

55809 Pyrotechnic filled molding powder. Hartzel, L.W.; Kettling, G.E. (to Dept. of Energy). US Patent 4,080,227. 21 Mar 1978. Filed date 6 Jun 1977. 6p.

PAT-APPL-804,190.

The disclosure relates to thermosetting molding compounds and more particularly to a pyrotechnic filled thermosetting compound comprising a blend of unfilled diallyl phthalate molding powder and a pyrotechnic mixture.

NUCLEAR

55810 (AD-A—048812) **Extended neutral wind modelling. Topical report, November 1975—June 1977.** Workman, J.B.; Chu, F.S.Y. (Physical Dynamics, Inc., Berkeley, CA (USA)). Jun 1977. Contract DNA001-76-C-0136. 59p. (PD-B—77-143). NTIS PC A04/MF A01.

The application of acoustic gravity wave mechanics to modelling neutral winds in the high altitude nuclear environment is discussed. Particular emphasis is placed on the problem of late time and large distance from the burst center. Specific work on coupling modes to hydro code output is reported. A technique to greatly extend the boundaries in scenario studies is also reported. (Author)

55811 (AD-A—049220) **The influence of clay and water in rocks on containment of underground nuclear explosions. Topical report.** Rimer, N. (Systems, Science and Software, La Jolla, CA (USA)). Jun 1977. Contract DNA001-77-C-0099. 43p. (SSS-R—77-3339). NTIS PC A03/MF A01.

This report describes a series of spherically symmetric calculations of the ground motions due to underground nuclear tests located in Nevada Test Site rocks of different clay and water contents. In particular, calculations of the Baneberry event, believed to be located in a rock of unusually high clay and water content, are compared with calculations for more typical NTS rocks. The Baneberry medium is thought to have considerably lower shear strength due to the abnormal clay and water contents. Calculations with these lower strengths showed far lower residual stress fields when compared to calculations for other media. A discussion of the relevance of these calculational results to containment is presented.

55812 (AD-A—049274) **An approximate solution for the response of a sphere in a tactical emp source region and estimates of coupling to an antenna. Technical memo.** Wilson, M.R. (Harry Diamond Labs., Washington, DC (USA)). Dec 1977. 27p. (HDL-TM—77-34). NTIS PC A03/MF A01.

Bombardt (1975) has discussed an early time model for the electromagnetic response of a sphere over a guard plane in the presence of source and conduction currents in the air. In this report the formal field solutions from this model are approximately evaluated via contour integration of inverse Laplace transforms. The resulting scattered radial electric field is used to estimate the electromagnetic pulse response of a sphere-mounted antenna.

55813 (AD-A—050039) **Special data collection system (SDCS) event report NTS event 'BANON', 26 August 1976. Technical report.** Dawkins, M.S.; Gillispie, M.D. (Teledyne Geotech, Alexandria, VA (USA)). 23 Nov 1977. 17p. (SDCS-ER—76-114). NTIS PC A02/MF A01.

This is the first SDCS report published incorporating data from Oak Springs Butte, Nevada (OB2NV) and NT-NV, two of the three stations at the Nevada Test Site. The third station, NT2NV is not yet operational. Included in this report are geologic surveys of the sites. Unfortunately, the data from these two new sites are unuseable in the hypocenter determination due to their close proximity to the event, the same being responsible for the extremely large ground motion which caused all the traces to clip.

55814 (AD-A—050114) **Near-surface nuclear dust cloud studies. Final report Mar 73—Feb 74.** Kirsch, J.W. (Systems, Science and Software, La Jolla, CA (USA)). Jan 1977. Contract DNA001-73-C-0128. 148p. (SSS-R—76-2828). NTIS PC A07/MF A01.

The report completes the documentation of SCOUR2 development and calculations. The results of approximately fifteen calculations of nuclear dust clouds are summarized in this report. They include surface burst calculations from 32.5 KT to 20 MT, and the results of the first SCOUR calculation with a precursor flow field (36.6 KT at 350 ft HOB). These results, although superseded by later SCOUR calculations, provide an excellent introduction to the predictive capacity of the SCOUR code. A comprehensive comparison is made between the SCOUR code predictions and experimental observations of the near-surface dust clouds produced by the MiDDLE GUST II (100 tons TNT) and MIXED COMPANY (500 tons TNT) high explosive detonations. Included are the results of the most recent (1975) SCOUR calculations that were made with an improved version of the SCOUR code. These results indicated that the nominal SCOUR prescription of dust lofting and diffusion parameters appear to be appropriate for the positive and early negative phase of these HE blast wave events.

55815 (AD-A—050118) **A study of the waveguide mode excitation and propagation in a parallel plate transmission line. Final report.** Crow, T.T.; Wu, K.Y.; Taylor, C.D. (Mississippi State Univ., Mississippi State (USA). Engineering and Industrial Research Station). Nov 1977. 64p. NTIS PC A04/MF A01.

A study of the waveguide mode excitation and propagation is made for a parallel plate waveguide. Since this configuration is used in the simulation of the nuclear electromagnetic pulse, results appropriate for various simulators are obtained and discussed. The analysis assumes infinitely wide plates, but the question of finite width plates is addressed.

55816 (AD-A—050186) **Identification of individual events in a multiple explosion from teleseismic short period body wave recordings. Topical report.** Lambert, D.G.; Bache, T.C. (Systems, Science and Software, La Jolla, CA (USA)). Oct 1977. Contract F08606-76-C-0041. 48p. (SSS-R—78-3421). NTIS PC A03/MF A01.

The objective of this study is to detect and identify the individual events in a hypothetical multiple explosion. The data analyzed are simulated short period body wave recordings of that event. These were, presumably, constructed by lagging, scaling and summing a single event record according to some formula unknown to the analysts. Data for two stations, including both the single event and multiple event records, were provided to Systems, Science and Software by the VELA Seismological Center (VSC). The data were analyzed by the MARS (Multiple Arrival Recognition System) program which uses a series of narrow-band filters to identify phase arrivals. Their amplitude and arrival time are accurately preserved. The variable frequency magnitude (VFM) discriminant is also computed and the multiple explosion records are clearly identified as being from an explosion.

55817 (AD-A—050463) **Correlation study of the UH-1B helicopter blast test results from the DICE-THROW event. Final report 1 Oct 76—31 May 77.** Zartarian, G.; Cole, E.L.; Lee, W.N. (Kaman Avidyne, Burlington, MA (USA)). Oct 1977. Contract DAAD05-76-C-0772. 218p. (KA-TR—138). NTIS PC A10/MF A01.

The results of a correlation study conducted in conjunction with the UH-1B helicopter blast test during the DICE THROW event are summarized. The processed structural and motion response data from the hovering and droned helicopter are presented. They are correlated with corresponding analytical predictions based primarily on the helicopter code HELP and the aircraft structural code NOVA-2. The monitored blast-induced responses include: (1) flapwise bending moments and the flapping angles of both the tail and main rotor blade systems; (2) latera bending moments at two fin and two tail boom stations; (3) overall rigid-body motions of the vehicle consisting of the altitude variations, the attitude and angular rate variations in the yaw, pitch, and roll degrees-of-freedom; and (4) strains at selected points on a tail boom panel, a stiffener, and a longeron. Considering the qualities of the available input data for the analyses and of the measurements, the experimental results are generally in reasonable agreement with the predictions from the HELP code. The NOVA-2 predictions for panel, stiffener, and longeron strains fare poorly when compared with experiment. In some instances, significant differences are found between experiment and analysis. Whenever possible, the reasons for the disagreements are identified and discussed.

55818 **Duration of nuclear explosion ground motion.** Hays, W.W.; King, K.W.; Park, R.B. (Denver Federal Center). *Bull. Seismol. Soc. Am.;* 68: No. 4, 1133-1145(Aug 1978).

This paper evaluates the duration of strong ground shaking that results from nuclear explosions and identifies some of the problems associated with its determination. Knowledge of the duration of horizontal ground shaking is important out to epicentral distances of about 44 km and 135 km, the approximate distances at which the ground shaking level falls to 0.01 g for nuclear explosions having yields of about 100 kt and 1,000 kt, respectively. Evaluation of the strong ground motions recorded from the event STRAIT (M/ sub L/ = 5.6) on a linear array of five, broad-band velocity seismographs deployed in the distance range 3.2 to 19.5 km provides information about the characteristics of the duration of ground shaking. The STRAIT data show that: (1) the definition that is used for defining duration is very important; (2) the duration of ground acceleration, as defined in terms of 90% of the integral of the squared time history, increased from about 4 to 26 sec over the approximately 20-km distance range; and (3) the duration of ground velocity and displacement were slightly greater because of the effect of the alluvium layer on the propagating surface waves. Data from other events augment the STRAIT data and show that: (1) duration of shaking is increased by frequency-dependent site effects and (2) duration of shaking, as defined by the integral of the squared time history, does not increase as rapidly with increase in yield as is indicated by other definitions of duration that are stated in terms of an amplitude threshold (e.g., bracketed duration, response envelopes). The available data suggest that the duration of ground acceleration, based on the integral definition, varies from about 4 to 40 sec for a 100-kt range explosion and from about 4 to 105 sec for a megaton range explosion in the epicentral distance range of 0 to 44 km and 0 to 135 km, respectively.

WEAPONRY

REFER ALSO TO CITATION(S) 55223

55819 (AD-A—049040) **Relative structural considerations for protection from injury and fatality at various overpressures. Final report, 17 June 1975—18 May 1977.** Longinow, A.; Wiedermann, A. (IIT Research Inst., Chicago, IL (USA)). Jun 1977. Contract DCPA01-75-C-0325. 133p. (IITRI-J—6365). NTIS PC A07/MF A01.

This report contains the results of a study concerned with producing casualty (injury and fatality) relationships for people located in conventional buildings when subjected to the direct effects produced by nuclear weapons. People survivability estimates for people located in conventional basements of multistory buildings subjected to blast effects of megaton range nuclear weapons are presented. Results are for full basements with two-way reinforced concrete overhead floor systems supported on steel beams. The transient velocity field that may exist in such basements is modeled and used to determine the response of individuals located within. Two models having different levels of sophistication are used to simulate individuals. Results are used in part to gauge the adequacy of the simpler model. The more sophisticated model is subsequently used to examine two closely related problems. The first considers the influence of anthropometric variation of individuals on the general nature of the blast translation problem (in the tumbling mode) and the severity of the resulting impact with floor and walls. The second examines the tumbling characteristics of individuals in a series of representative flow environments.

55820 (AD-A—050417) **AFWL technical objective number 1. Nuclear weapons, non-conventional weapons, direct systems support, and supporting technology, fiscal year 1979. Final technical report Jan 78—Jan 79.** Collier, W.D. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Dec 1977. 41p. (AFWL-TR—77-216). NTIS PC A03/MF A01.

Present DOD/USAF strategic planning is based on the ability of strategic weapon systems to survive and operate through an attack employing megaton nuclear weapons. The energy radiated after the detonation of a nuclear device takes many forms (EMP, X-ray, gamma ray, thermal, blast, etc.) and is of sufficient amplitude and energy to seriously degrade or negate the systems under attack. As the design and interdependence of advanced systems become more intricate and the potential attacking force achieves greater numbers and sophistication, survival requirements become greater for those systems. Definition of the environment must be determined and improved as the postulated threat is revised or refined. Analysis

and simulation techniques must be devised to be used in testing and assessing the survivability/vulnerability of Air Force systems. Every US Air Force aircraft and missile system with a nuclear capability must be conceived, developed, built, and operated in accordance with nuclear safety standards. The Air Force must assure itself that systems being developed with a nuclear capability or which might potentially operate in a nuclear environment have characteristics that are compatible with design, safety, and operational requirements of the Air Force. Air Force regulations and DOE DOD agreements provide for the systematic integration of safety features into Air Force nuclear systems during all phases of development, acquisition, and operational employment. DOE must be provided with criteria, requirements, and guidance on nuclear bomb/warhead development and integration with specific delivery systems to ensure compatibility with Air Force systems.

55821 **Kernexplosionen fuer friedliche Zwecke. (Nuclear explosions for peaceful purposes).** Schuricht, V. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). Berlin; Akademie-Verlag (1977). 139p. (In German).

Theoretical and technological aspects as well as peaceful applications of nuclear explosions are discussed ecphasizing contained and cratering explosions. For both types of explosions phenomenology as well as the dimensions of the cavity and chimney or of the crater and their predictability are described. As regards engineering applications, e.g., canal and harbour construction, industrial applications, e.g., oil reservoir stimulation, oil shale recovery, natural gas stimulation and storage, in-situ mineral recovery, and scientific applications, e.g., in neutron physics and geophysics, were studied. Safety aspects are discussed considering air-blast effects, soil movement and radiological effects depending on the two types of explosions. Finally, several national programs are outlined.

EXPLOSION DETECTION

55822 (AD-A—049958) **Seismic studies of surface and body waves for improved yield determination. Quarterly report 1 Jul—30 Sep 77.** Bache, T.C.; Rodi, W.L. (Systems, Science and Software, La Jolla, CA (USA)). Oct 1977. Contract F08606-76-C-0041. 88p. (SSS-R—78-3448). NTIS PC A05/MF A01.

The results of two research projects not previously reported are described. One of these, Determination of Crustal Structure from Surface Wave Dispersion Data, describes a recently developed method for obtaining crustal structure and gives results from application of this method to two paths in the Southwestern United States: Nevada Test Site (NTS) to Albuquerque, New Mexico and NTS to Tucson, Arizona. Phase and group velocities are determined from NTS explosion recordings. Theoretical seismograms computed with the new crustal models show remarkable agreement with observations of NTS explosions at the two stations. The second research study described is entitled Small-Scale Laboratory Simulations of Explosion Produced Body Waves - Implications for the Teleseismic Signatures of Underground Nuclear Explosions. Small-scale laboratory experiments were carried out to measure the ground motions from spherical charges. The most important feature of the experimental data is a large negative pulse that occurs at late-time in the experiments that include free-surface effects. Much of the study is directed toward determining the effect a pulse of this kind would have on the teleseismic body waves from nuclear explosions and m sub b-log yield relations.

55823 (AD-A—050584) **Seismic discrimination. Semiannual technical summary report 1 Apr-30 Sep 77.** Chinnery, M.A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 30 Sep 1977. Contract F19628-76-C-0002,. 86p. NTIS PC A05/MF A01.

Investigations in the field of seismic discrimination are described. The information is grouped as follows: surface-wave studies , studies of seismic scaling and body-wave magnitude mb , miscellaneous studies , and investigations related to data analysis and computer systems.

55824 (NTIS/PS—78/0252) **Seismic detection. Part 2. Nuclear events. Volume 3. 1975-February, 1978 (a bibliography with abstracts). Report for 1975-feb 78.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 297p.

Methods of seismic detection of nuclear events are investigated in the Government sponsored research reports. Data acquisition techniques, data processing, and data collection sources are reviewed. (This updated bibliography contains 292 abstracts, 46 of which are new entries to the previous edition.)

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 55899

55825 (DP—1451) **Tornado activity at SRP during 1976.** Pepper, D.W.; Schubert, J.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1978. Contract EY-76-C-09-0001. 23p. Dep. NTIS, PC A02/MF A01.

Tracks of three small tornadoes were confirmed on the site of the Savannah River Plant during 1976. Only minor damage to buildings and vehicles was experienced. The tornadoes were rated F1 on the Fujita-Pearson scale. Synoptic weather conditions from the National Weather Service and from the SRP seven-tower data system were recorded.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 54352, 54355, 54504, 54942, 54943, 54946, 55850, 55852, 55926, 55929, 56290, 56301

55826 (AD-A—049030) **Stratospheric composition balloon-borne experiment 23—26 September 1975. Research and development technical report.** Ballard, H.N.; Hudson, F.P. (Army Electronics Command, Fort Monmouth, NJ (USA)). Oct 1977. 123p. (ECOM—5830). NTIS PC A06/MF A01.

Within the period September 1968 to September 1975, six balloon-borne experiments were conducted under the title of 'STRATospheric COMPosition (STRATCOM) Experiments.' The initial experiments (September 1968 and September 1969) were designed to measure the temperature variations near an altitude of 50 km that were to be associated with the diurnal stratospheric tide. Requirements by the Department of Defense for information concerning stratospheric composition, as well as measurements of national interest to the possible pollution of the stratosphere by the Super Sonic Transport and by chlorofluorocarbons, gradually increased the number, types, and complexity of measurements conducted during each successive experiment. This composite report presents, in one publication, the related results obtained from the various experiments comprising the STRATCOM VI-A and VI-B payloads as determined by the various experimenters. The results, coupled with the ECOM Report 'Correlation of Selected Atmospheric Composition Parameters for the Mid-Latitude September Stratosphere,' are representative of the correlated multi-instrument approach of the STRATCOM Program to the experimental study of the stratosphere, backed by chemical kenetic theory and atmospheric modeling.

55827 (BNL—24352) **Measurement of biological activity of ambient air mixtures using a mobile laboratory for in situ exposures: preliminary results from the Tradescantia plant test system.** Schairer, L.A.; Van't Hof, J.; Hayes, C.G.; Burton, R.M.; de Serres, F.J. (Brookhaven National Lab., Upton, NY (USA); Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.; National Inst. of Environmental Health Sciences, Research Triangle Park, NC (USA)). 1978. Contract EY-76-C-02-0016. 25p. (CONF-780227—7). Dep. NTIS, PC A02/MF A01.

From Symposium on application of short-term bioassays in the fractionation and analysis of complex environmental mixtures; Williamsburg, VA, USA (21 Feb 1978).

A variety of short-term bioassays has been developed to assess the mutagenicity of industrial chemicals. Many of these assays work well when used under laboratory conditions but are not suitable for monitoring ambient air under field conditions. To facilitate exposures of biological systems to ambient air pollution in natural or industrial sites a plan was implemented to design, assemble and test a mobile laboratory. The Tradescantia plant test system was chosen for these initial field studies because of its high sensitivity to both physical and chemical mutagens and its versatility and adaptability to monitoring the mutagenicity of gaseous pollutants. Positive results to date support the further development of the mobile laboratory and Tradescantia system as a useful method for monitoring biological activity of complex environmental mixtures in situ.

55828 (BNL—24383) **Modeling homogeneous oxidation of atmospheric SO_2 by a surrogate CHEmical MEchanism (SCHEME).** Levine, S.Z.; Schwartz, S.E. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 10p. (CONF-780902—7). Dep. NTIS, PC A02/MF A01.

From American Chemical Society meeting; Miami, FL, USA (10 Sep 1978).

The introduction of contaminant sulfur dioxide into the troposphere and its eventual oxidation to sulfate is a well recognized and important consequence of fossil-fuel combustion; however, the combined complexities of chemical transformation and long-range transport have made it difficult to formulate effective strategies for the control of atmospheric sulfur pollutants. The formulation of such strategies depends, in large part, upon an examination and understanding of these chemical and physical processes as gained by the use of regional transport models. These models in turn require the incorporation of a kinetic mechanism to describe SO_2 oxidation. In the industrial-urban community, emissions from numerous and varying sources will introduce and mix together into the troposphere gaseous pollutants including nitrogen oxides and hydrocarbons as well as sulfur dioxide. These gases will then undergo complex chemical transformations leading to the formation of secondary pollutants such as photochemical oxidants and sulfates. During the past decade, extensive research has led to an increased understanding of the gas-phase kinetics and mechanisms involved in these transformations. It is now apparent that homogeneous oxidation of SO_2 occurs by gas-phase reactions with several free-radicals whose concentrations themselves depend upon the presence and history of other atmospheric constituents including NO, NO_2, O_3, CO, and hydrocarbon. Thus, a detailed kinetic mechanism for the homogeneous oxidation of SO_2 may include tens of different reactants, products, and intermediate species associated with the photochemistry of the so-called urban smog reactions.

55829 (BNL—24610) **Construction of surrogate CHEmical MEchanisms (SCHEMEs) for atmospheric photochemical systems.** Levine, S.Z.; Schwartz, S.E. (Brookhaven National Lab., Upton, NY (USA)). 1978. Contract EY-76-C-02-0016. 4p. (CONF-780832—1). Dep. NTIS, PC A02/MF A01.

From 9. conference on photochemistry; Cambridge, UK (7 Aug 1978).

During the past several years it has become apparent that homogeneous gas-phase reactions of pollutants in the troposphere, i.e., the formation of photochemical smog and the oxidation of SO_2, occur to a great extent by elementary reactions involving chain carrying free-radicals (HO, HO_2, RO, RO_2, $RCOO_2$) whose concentrations are governed by the concentrations of trace molecular constituents including NO, NO_2, CO, O_3, and organics, as well as sunlight. For the purpose of modeling chemical transformations in the ambient atmosphere, which requires incorporating a reaction mechanism within an atmospheric transport model, it is necessary to develop a mechanism that includes a minimum number of chemical species, since the computational time and cost involved in solving the set of partial differential equations describing the diffusion-advection-reaction problem increases dramatically with the number of species modeled. Although photochemicl mechanisms employing fewer than 15 species have been developed previously for use within urban airshed models, those reduced, or surrogate, mechanisms do not include sulfur chemistry and do not appear applicable to the more widely varying conditions possible as gases become chemically depleted while being transported away from emission sources. Therefore, in order to meet the time and cost constraints of an atmospheric transport model, we have constructed a 12-species Surrogate CHEmical MEchanism (SCHEME) incorporating reactions for the homogeneous gas-phase oxidation of SO_2. A preliminary but much more detailed and comprehensive ATmospheric Model for Sulfur (ATMOS) has been used to generate SCHEME and test its applicability to a broad range of chemical conditions.

55830 (CONF-780636—7) **Benefits and costs of maintaining short-term sulfur dioxide standards in non-urban areas. Paper 78-52.4.** Cohen, A.S. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 16p. Dep. NTIS, PC A02/MF A01.

From 71. Air Pollution Control Association meeting; Houston, TX, USA (25 Jun 1978).

The body of information presented in this paper is directed toward air pollution control officials, environmental economists, and environmental systems analysts. The objective of this paper is to evaluate the economics of various alternatives for maintaining the short-term SO_2 standards. This is done by estimating the benefit and cost of meeting a mass-emission limit designed to ensure compliance with short-term SO_2 standards. A case study approach is taken using rural Illinois as the study area. The benefits considered are largely the result of avoiding physical damages that would occur at high pollution levels. These damages are of three principal types: mortality, morbidity, and material damages. Permanent controls to comply with SO_2 and particulate matter emission limits are assumed to involve the installation of scrubbers, particulate control equipment, and/or fuel switching. Short-term controls include load and fuel switching and reducing output. The results of the analysis indicate that there can be considerable economic advantages if short-term solutions are used on a permanent basis to maintain short-term SO_2 standards in rural areas where the annual standards are not threatened.

55831 (CONF-780636—11) **Recent measurements of the rates of ozone removal from the atmosphere by land surfaces. Paper 78-30.5.** Wesely, M.L.; Eastman, J.A.; Cook, D.R.; Hicks, B.B. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From 71. Air Pollution Control Association meeting; Houston, TX, USA (25 Jun 1978).

The factors that control the uptake of airborne pollutants at land surfaces are highly varied and depend to a large extent on the chemical properties of the pollutant considered. Since ozone is not very soluble in pure water and is highly reactive with many substances, its uptake or destruction should be retarded by liquid water but enhanced by biological activity that produces substances susceptible to attack by ozone. It would appear that the variability in surface resistance to uptake of ozone is quite large due to the great natural variations in chemical composition, temperature, and water content of outdoor surfaces. Thus, the rates of removal of ozone from the atmosphere can be difficult to predict when flow over numerous kinds of surfaces is involved, such as in episodes of rather high ozone concentrations that occur over regional-scale distances (about 1000 km). The purpose of the present study is to examine measurements of ozone flux obtained directly by eddy-correlation techniques above certain agricultural surfaces, and to determine the surface properties, including estimated stomatal resistance, that are important in regulating the rate of ozone destruction at the surface. The two experimental sites were a large field of full-grown, healthy maize in Sangamon County near Springfield, Illinois, and the second site was a field of senescent maize in Rush County near Indianapolis, Indiana.

55832 (DP-MS—77-93) **Parameter estimation for predictions of the dry removal of gases by ecosystems.** Murphy, C.E. Jr.; Schubert, J.F.; Dexter, A.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1978. Contract EY-76-C-09-0001. 20p. (CONF-780611—11). Dep. NTIS, PC A02/MF A01.

From AIChE symposium; Philadelphia, PA, USA (4 Jun 1978).

A model of the dry removal of gaseous pollutants by forest trees is presented. A method for estimating the parameters of this model from existing experimental data is also developed, and sample calculations are made for the removal of tritiated hydrogen gas from the atmosphere.

55833 **Programmable data acquisition system for solar engineering and environmental protection.** Meilhaus, A. (Meilhaus Electronic, Muenchen (Germany, F.R.)). *Mess. Pruef.;* No. 1/2, 25-26, 51(Jan 1978). (In German).

Under the aspects of conservation of fossil energies and of a reduction of environmental pollution, a new data acquisition system is of interest for monitoring tasks in solar energy plants as well as for environmental protection measures. The results obtained so far with its use in the USA agree well with European conditions.

55834 (NTIS/PS—78/0109) **Diesel exhaust emissions (citations from the NTIS data base). Report for 1964—February 1978.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1978. 181p. NTIS PC N01/MF N01.

Aspects of exhaust gases from stationary and vehicular diesel engines are presented in these citations of Federally-funded research. This includes their pollution potential, composition, control, and formation processes in combustion reactions. The effects of achieving better fuel consumption on the types of exhaust gases formed is covered. Also cited is research concerned with the health effects of these exhaust gases. (This updated bibliography contains 176 abstracts, 36 of which are new entries to the previous edition.)

55835 (NTIS/PS—78/0183) **Air pollution tracer studies in the lower atmosphere (a bibliography with abstracts). Report for 1964-Feb 78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 125p. NTIS PC N01/MF N01.

The cited reports cover research on the use of tracers to study lower atmospheric air pollution movements. The tracers used include sulfur hexafluoride, krypton-85, carbon-14, and other radioactive isotopes. The studies cite the results and techniques used, tracer movement from nuclear power plants, industrial stacks, urban areas, and the detectors used in their measurement.

55836 (ORNL/EIS—132) **Environmental/chemical thesaurus.** Shriner, C.R.; Dailey, N.S.; Jordan, A.C.; Miller, K.C.; Owens, E.T.; Rickert, L.W. (Oak Ridge National Lab., TN (USA)). Jun 1978. Contract W-7405-ENG-26. 312p. Dep. NTIS, PC A14/MF A01.

The Environmental/Chemical Thesaurus approaches scientific language control problems from a multidisciplinary view. The Environmental/Biomedical Terminology Index (EBTI) was used as a base for the present thesaurus. The Environmental/Chemical The-

saurus, funded by the Environmental Protection Agency, used as its source of new terms those major terms found in 13 Environmental Protection Agency data bases. The scope of this thesaurus includes not only environmental and biomedical sciences, but also the physical sciences with emphasis placed on chemistry. Specific chemical compounds are not included; only classes of chemicals are given. To adhere to this level of classification, drugs and pesticides are identified by class rather than by specific chemical name. An attempt was also made to expand the areas of sociology and economics. Terminology dealing with law, demography, and geography was expanded. Proper names of languages and races were excluded. Geographic terms were expanded to include proper names for oceans, continents, major lakes, rivers, and islands. Political divisions were added to allow for proper names of countries and states. With such a broad scope, terminology for specific sciences does not provide for indexing to the lowest levels in plant, animal, or chemical classifications.

55837 (PB—277732) **Atmospheric tracer studies to characterize the transport and dispersion of pollutants in the California delta region. executive summary. Final report.** Lamb, B.K.; Shair, F.H. (California Inst. of Tech., Pasadena (USA). Div. of Chemistry and Chemical Engineering). 15 Jun 1977. Contract ARB-A5-065-87. 78p.

Eight tracer studies were conducted during four designated meteorological periods in 1976 to quantitatively determine the transport and dispersion characteristics of the air passing over a proposed industrial site in the Montezuma Hills. On the average, plumes emitted from the Montezuma Hills during the test periods were transported southeast. Estimates of tracer concentrations based upon the Gaussian plume model were found to be reasonably accurate. A nomograph was developed to permit rapid calculation of non-reactive pollutant concentrations from tracer data and pollutant emission rates; in the case of NO_2, the oxidation of NO to NO_2 was assumed to be rapid relative to the transport time. The nomograph was used to predict ground level concentrations of pollutants resulting from the projected emissions associated with the proposed Dow complex in the Montezuma Hills. A reasonable correlation was found to exist between the horizontal standard deviation of the wind, sigma(y), and the horizontal dispersion parameter of the plume, sigma(y). The correlation between sigma(theta) and sigma(y), along with air parcel trajectory analysis, provide a means for extending the results of this study to other periods of the year.

55838 (PB—277733) **Atmospheric tracer studies to characterize the transport and dispersion of pollutants in the California delta region. Volume I. Presentation and discussion of results. Final report.** Lamb, B.K.; Shair, F.H. (California Inst. of Tech., Pasadena (USA). Div. of Chemistry and Chemical Engineering). 15 Jun 1977. Contract ARB-A5-065-87. 284p.

Contents: Introduction--(Industrialization of the California Delta Region, Literature review, and Objectives of the California Delta Tracer Study); Meteorology and topography of the California Delta Region; Experimental procedure; Presentation and discussion of results; Calculation of the surface wind field.

55839 (PB—278302) **Fiscal year 1976 summary report of NOAA meteorology laboratory support to the Environmental Protection Agency. Technical memo.** Viebrock, H.J. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Jul 1977. 171p. (NOAA-TM-ERL-ARL—67).

During Fiscal Year 1976, the Meteorology Laboratory continued to provide research and operational support to the Environmental Protection Agency. Operational support included review of the meteorological aspects of environmental impact statements, implementation plans, and grant and contract proposals; the application of dispersion models; and conduct of dispersion studies and evaluations. Research support was in the areas of model development and application, and climatic analysis. Dispersion models for inert and reactive pollutants on all temporal and spatial scales continued under development and evaluation. Work was begun on long-distance dispersion model development. Boundary layer meteorological field experiments leading to the development of boundary layer models were conducted. The Fluid Modeling Facility conducted experiments in neutral atmospheres in the wind tunnel, and began experiments on dispersion in stratified atmospheres.

55840 (PNL—2670) **Radiological and toxicological assessment of an external heat (burn) test of the 105MM cartridge, APFSDS-T, XM-744.** Gilchrist, R.L.; Parker, G.B.; Mishima, J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1978. Contract EY-76-C-06-1830. 37p. Dep. NTIS, PC A03/MF A01.

The potential radiological and toxicological hazard of depleted uranium aerosol release was investigated. This type of release might arise from accidents with XM-774 ammunition involving great heat. Twelve rounds of packaged ammunition were subjected to an external heat (burn) test. Examination of the site on the day following the test revealed that all 12 depleted uranium penetrators were completely intact. Oxidation of the penetrators was not apparent, even on the most severely burned projectile located at ground zero. Eleven of the 12 projectiles were recovered with the sabots intact; some sabots appeared charred. It was concluded that no airborne release of depleted uranium had occurred and subsequently there had been no radiological or toxicological hazard from DU during this test. However, this conclusion may not apply to the release of depleted uranium in other types of fires involving this ammunition because other factors may affect the fire. These factors include type of fuel, number of ammunition rounds, and type of structure housing the ammunition.

55841 (UCRL—52000-78-1, pp 17-25) **Ozone layer: assessing man-made perturbations.** Luther, F.M. Jan 1978.

In Energy and technology review.

Since 1972, LLL has been using numerical models to assess the potential chemical impacts on the ozone layer of engine effluents from high-altitude supersonic and subsonic aircraft and their subsequent climatic results. Since 1974, we have been assessing how nitrogen oxides from atmospheric nuclear explosions affect this layer. In addition, we are studying the potential environmental effects of chlorofluoromethanes, which are used as aerosol spray propellants, refrigerants, and foaming agents. The rapid evolution of our understanding of atmospheric chemistry and other physical processes has led to major changes in these environmental assessments.

55842 **Time of flight aerosol beam spectrometry: a new technique for measuring airborne particulates.** Dahneke, B. (Univ. of Rochester, NY). pp 271-277 of Atmospheric pollution. Benarie, M.M. (ed.). Amsterdam; Elsevier Scientific Publishing Co. (1976).

From 12. international colloquium on atmospheric pollution; Paris, France (5 May 1976).

When an aerosol expands through an orifice or nozzle into a vacuum chamber, particles of different "aerodynamic size" obtain different terminal velocities in the vacuum chamber. Smaller particles, having smaller inertia, closely follow the motion of the highly accelerating gas in the nozzle jet and obtain high terminal velocities in the vacuum chamber. Larger particles lag the gas motion and obtain lower terminal velocities. Measurement of the distribution in particle terminal velocities or, equivalently, particle times of flight over some fixed path length thus provides a measure of the aerodynamic size distribution of the particles. A simple prototype instrument for measuring particle times of flight was built and tested by the present author [Nature Phys. Sci. 244, 54 (1973)]. The results demonstrated the potential value of the technique. This paper describes a more sophisticated instrument capable of real time measurement, analysis and display of particulate size distributions. The instrument is suitable for field measurements. Example results are presented.

55843 **Serum lipoprotein concentrations in cystic fibrosis.** Vaughan, W.J. (Univ. of California, Berkeley); Lindgren, F.T.; Whalen, J.B.; Abraham, S. *Science;* **200**: No. 4330, 783-786(17 Feb 1978).

Two major classes of lipoproteins, low density and high density, are decreased in the serum of patients with cystic fibrosis; major apoproteins are also decreased. Since essential fatty acids and certain fat-soluble vitamins depend on lipoproteins for transport in the serum, knowledge of lipoprotein levels in cystic fibrosis patients could prove valuable in understanding (i) the basis for the abnormally low serum levels of these fatty acids and vitamins and (ii) the effects of therapies involving these molecules.

55844 **CO_2 problem: possible solutions by technical countermeasures.** Bach, W. (Muenster Univ. (Germany, F.R.). Forschungsstelle fuer Angewandte Klimatologie und Umweltstudien). *Umsch. Wiss. Tech.;* **78**: No. 4, 117-118(Feb 1978). (In German).

If we continue to burn fossil fuels, a global temperature rise of 1°C must be reckoned with for the year 2000; in 2050, it will be 3 to 4°C. Preventive measures are discussed, e.g.: Reducing the combustion of fossil fuels, removing CO_2 before emission, establishing a carbon bank, discharging CO_2 into the deep sea. Model calculations indicate that it might be possible to prevent the expected temperature rise by a world-wide energy mix.

55845 **Distribution of pollutants, especially of nitrogen oxides, in the atmosphere.** Gilbert, T. *Glastech. Ber.;* **51**: No. 6, 152-155(1978). (In German).

From Conference on emissions from glass melting furnaces; Frankfurt am Main, Germany, F.R. (28 Oct 1977).

The methods used for the last twenty years to estimate the dispersion of atmospheric pollutants in the German Federal Republic have left many questions unanswered. Likewise the method for calculating minimum required chimney height given in no. 2.6 of the 1964 and 1974 TA Luft is only for very idealized conditions. Matters of particular concern include the buoyancy of waste gases in the atmosphere and, for oxides of nitrogen, how much is emitted as NO_2. The introduction of the 1974 TA Luft significantly tightened limits for emission of nitrogen oxides. These limits could, in some cases,

require much increased stack height in otherwise similar circumstances. The limits on other pollutants have not been so severely changed.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 54715, 54720, 54721, 55832, 55840

55846 (MLM—2546(OP)) **Demonstration of an Emergency Containment System.** Flanagan, T.M.; Rogers, M.L.; Wilkes, W.R. (Mound Facility, Miamisburg, OH (USA)). 1978. Contract EY-76-C-04-0053. 12p. (CONF-780819—11). Dep. NTIS, PC A02/MF A01.

From 15. nuclear air cleaning conference; Boston, MA, USA (Aug 1978).

A system called an Emergency Containment System (ECS) to be used for tertiary containment of tritium was reported at the 13th Air Cleaning Conference. This system was part of the Tritium Effluent Control Laboratory then under construction at Mound Facility. A series of experiments has recently been conducted to evaluate the performance of an ECS in capturing tritium accidentally released into an operating laboratory. The ECS is an automatically actuated laboratory air detritiation system utilizing a catalytic oxidation reactor and presaturated oxide adsorption/exchange columns. In the event of an accidental release of tritium into the laboratory, the ECS is automatically activated, and quick-acting pneumatic dampers divert the laboratory air supply and exhaust through the ECS until room concentrations are returned to safe operating levels. The results of the experiments have shown that a tertiary containment of tritium is feasible. In the event of a catastrophic accident, the ECS is capable of preventing the release of a large quantity of tritium to the environment.

55847 (NVO—0410-47) **Environmental surveillance report for the Nevada Test Site, July 1975—December 1977.** Lantz, M.W. (comp.). (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)). Jul 1978. Contract EY-76-C-08-0410. 150p. Dep. NTIS, PC A07/MF A01.

The results obtained from this environmental monitoring program for the reporting period of July 1975, through December 1977, show that the radioactivity in the NTS environments was low compared to the ERDA guidelines. The maximum average gross beta concentration in air for the entire network was recorded during July-December 1977 (4.1×10^{-13} μCi/cc). This average represents 1.4% of the applicable Concentration Guide of 3×10^{-11} μCi/cc as listed in ERDA Manual Chapter 0524, Annex A (assuming Sr-90 to be the most radiotoxic beta emitter present). The range of the year's station averages was 1.9×10^{-14} to 3.5×10^{-14} μCi/cc. These values seem to be indicative of a baseline, or background, level of gross beta at NTS because the plots have no upward or downward trend over this time period. Plutonium-239 concentrations in air were primarily below 10^{-16} μCi/cc as compared with a CG of 6×10^{-14} μCi/cc as listed in ERDA Manual Chapter 0524, Annex A. Two surveillance stations indicated consistently higher plutonium values, and an increased sampling program has been instituted. The tritium concentrations in air measured at the control station, Building 650 (Mercury), were similar to those found at offsite locations. The highest concentration of HTO was 2.5×10^{-11} μCi/cc. Most HT measurements were below the minimum detectable limits (MDL). Measurements of radioactivity in the principal NTS water distribution system showed that no release or movement of radionuclides occurred during the reporting period.

55848 (PB—277828) **Dispersion in the wake of a model industrial complex. Topical report Jan 76—Jun 77.** Hatcher, R.V.; Meroney, R.N.; Peterka, J.A.; Kothari, K. (Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering). Nov 1977. Contract AT(49-24)-0236. 246p. NTIS PC A11/MF A01.

Both routine and inadvertent releases of hazardous materials or contaminants may occur at industrial sites. For example small releases of radioactivity are made when a buildup occurs in the working area of a nuclear reactor complex. The nuclear reactor plant itself is usually enclosed within a protective shell which is intended to prevent the accidental release of radioactive pollutants into the atmosphere. However should a crack or leak develop in the shell large amounts of radioactivity could be released. This study deals with the fate of contaminants released into the atmosphere under a variety of release situations. 1:200 scale models of the EOCR reactor building and surrounding silo and tank buildings at the Idaho National Engineering Laboratory, Idaho Falls, Idaho were put into the Meteorological Wind Tunnel at Colorado State University. Flow visualization used titanium-tetrachloride as a visible tracer gas. Concentration measurements were accomplished using ethane and propane as tracer gases, and gas chromatography techniques. The test program consisted of systematic releases from the base on the northwest face, center rooftop and the stack. In each case the release rate was maintained at low rates such that no appreciable jetting or plume rise was present. The program was repeated for cases of moderately unstable, neutral, moderately stable, and stable conditions in the wind tunnel. (Portions of this document are not fully legible)

55849 (RFP-ENV—77) **Annual environmental monitoring report, January—December 1977.** (Atomics International Div., Golden, CO (USA). Rocky Flats Plant). 25 Apr 1978. Contract EY-76-C-04-3533. 38p. Dep. NTIS, PC A03/MF A01.

During 1977, the Rocky Flats Plant conducted an environmental monitoring program that included the sampling and analysis of air, water, and soil on and off the plant site. Also, measurements of penetrating-radiation dose in the environment were made using thermoluminescent dosimeters (TLD's). Particulate samples were collected from air samplers that operated continuously at distances of 3 to 6 kilometers (2 to 4 miles) from the Plant and in 12 communities that range approximately 19 to 26 kilometers (12 to 16 miles) from the Plant. Analysis of these samples indicated that the levels of airborne plutonium in communities surrounding the Plant were within the range attributed to fallout from atmospheric nuclear weapons testing. During 1977, all sanitary wastes were processed through a tertiary treatment facility before being discharged from the Plant. Five daily fluoride concentrations exceeded the daily maximum limitation of 1.7 mg/l. Two daily biochemical oxygen demand concentrations exceeded the daily maximum limitation of 25 mg/l. The plutonium, uranium, americium, and tritium radioactivity concentrations measured in Great Western Reservoir and in Standley Lake during 1977 were found to be less than 0.08 percent of the applicable RCG. Plutonium, uranium, and americium radioactivity concentrations measured in the drinking water from nine communities in the area averaged less than 0.04 percent of the applicable RCG. Analysis of 57 soil samples collected during 1977 indicated little change in the plutonium concentration in soil. An assessment was made of the potential Plant contribution in 1977 to public radiation dose. Results indicated that the maximum individual dose for that year at the Plant perimeter was approximately 0.17 millirem per year. Total dose to the population living within 80 kilometers (50 miles) was calculated to be 208 man-rem.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

55850 **Estimation of downwind viable airborne microbes from a wet cooling tower: including settling.** Peterson, E.W.; Lighthart, B. (Environmental Protection Agency, Corvallis, OR). *Microb. Ecol.;* **4**: No. 1, 67-69(1977).

In recent years, reuse of municipal waste water as the coolant in drift-producing cooling towers at electrical generating plants has become increasingly common. A hueristic model is presented that can be used to estimate the concentrations of viable airborne microbes in the drift from a wet cooling tower given the concentration of microbes in the cooling tower. The purpose of this presentation is to allow the nonmeteorologist to understand the factors affecting airborne concentration and to make crude estimates of ground-level concentrations of airborne microorganisms. Concentrations are calculated using a standard meteorological method, the Gaussian dispersion model, in which terms have been included for droplet settling and microbial death rate.

REGULATIONS

REFER ALSO TO CITATION(S) 55845

55851 (ANL/EES-CP—9) **Estimating the cost for states to implement federal air pollution control strategies.** Senew, M.; Conley, L.; Seymour, D.; Cirillo, R.; Donaldson, T. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 22p. (CONF-780636—10). Dep. NTIS, PC A02/MF A01.

From 71. Air Pollution Control Association meeting; Houston, TX, USA (25 Jun 1978).

In the process of developing environmental regulations and control strategies, it is helpful and often necessary to estimate costs associated with alternate approaches. Compliance costs to the private sector as well as implementation costs to enforcement agencies must be considered. To assist estimating state administrative and enforcement costs the U.S. Environmental Protection Agency has developed a planning aid which provides a detailed review of enforcement agency activities quickly, minimizing the time required to collect source, monitoring, and cost data. The Air Pollution Control Strategy Resource Estimator (APCSRE) is a computerized model which operates with an updated data base of NEDS,

SAROAD, and cost information. After calling the APCSRE model on an EPA terminal, the user defines the strategy to be evaluated. After a question and answer session the APCSRE model estimates expected manpower, equipment, and total dollar costs for implementation of the strategy. This paper describes the APSCRE model and illustrates its application by estimating resource costs associated with implementation of an ambient lead standard and a continuous emission monitoring regulation.

55852 Uniform practice within the Federal Republic in monitoring emissions from facilities according to the Federal Act on the Protection against Nuisances. Guidelines for aptitude tests, the installation and the maintenance of integrators for continuously recording emission measurement equipment. *Gemeinsames Ministerialbl., A;* **29**: No. 9, 3(Apr 1978). (In German).

The guidelines refer to: 1.) the minimum requirements to be made on integrators for continuously recording emission measurement equipment during prototype tests; 2.) the installation and the maintenance of integrators; 3.) institutes suitable to carry out this prototype test; and 4.) the publication of suitable integrators.

55853 Status of the Clean Air Act: impact on mineral production. Wallop, M. (Senate, Washington, DC). pp 9p, Set No. 5, Paper 1 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 54348, 55899

55854 (RHO-SA—31) **Finite element models for simultaneous heat and moisture transport in unsaturated soils.** Baca, R.G.; King, I.P.; Norton, W.R. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations; Resource Management Associates, Lafayette, CA (USA)). Mar 1978. Contract EY-77-C-06-1030. 30p. (CONF-780717—3). Dep. NTIS, PC A03/MF A01.

From 2. conference on finite elements in water resources; London, UK (10 Jul 1978).

A finite element model for use in the analysis of transport processes in arid site vadose zones is described and demonstrated. The numerical model is designed to provide detailed simulations of the interactions between climatic conditions and natural moisture movement in a dry soil system. The theoretical framework of the models considers processes of coupled heat and moisture transport, soil-atmosphere interactions, and spatially varying soil properties.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 55855, 55856, 55857, 55937

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 55836, 55867

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 54721

55855 (PNL-SA—6695) **TRAN-STAT, Issue No. 1, September 1977. Topics discussed: quantitative aspects of Pu field studies.** Gilbert, R.O. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1977. Contract EY-76-C-06-1830. 4p. Dep. NTIS, PC A02/MF A01.

The purpose of TRAN-STAT is to stimulate thinking about how better use can be made of statistics in the design and analysis of environmental transuranic studies. Topics discussed include current statistical studies on the quantitative aspects of plutonium field studies, appropriate data summaries for transuranic studies, and new statistical references of interest.

55856 (PNL-SA—6696) **TRAN-STAT, Issue No. 2, November 1977. Topics discussed: some statistical aspects in the evaluation of environmental transuranic contamination for possible remedial action.** Gilbert, R.O. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1977. Contract EY-76-C-06-1830. 8p. Dep. NTIS, PC A02/MF A01.

Some statistical aspects surrounding the question of whether an area contaminated to some extent by transuranium elements requires some type of remedial action to guard against a possible health hazard to man are discussed. It is assumed that an upper limit on the level of contamination in soil has been set and that the main problem is to collect environmental soil sampled in order to make a decision whether the area being samples does exceed the agreed upon limits. Methods discussed involve the specifications of two types of errors that can be made when deciding whether a specified land area being sampled requires action. These are taking remedial action when none is required and not taking remedial action when such action should be taken. These two types of errors are referred to by statisticians as Type I and Type II errors respectively. In practice, one can never be absolutely sure that he has not made one of these errors since the entire area cannot be sampled. In the absence of complete knowledge there is always the possibility of error. A statistical problem is to determine the number, type, and placement of samples to insure that the probability of making these two types of errors is not too large.

55857 (PNL-SA—6697) **TRAN-STAT, Issue No. 3, January 1978. Topics discussed: some statistical aspects of compositing field samples.** Gilbert, R.O. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1978. Contract EY-76-C-06-1830. 22p. Dep. NTIS, PC A02/MF A01.

Some statistical aspects of compositing field samples of soils for determining the content of Pu are discussed. Some of the potential problems involved in pooling samples are reviewed. This is followed by more detailed discussions and examples of compositing designs, adequacy of mixing, statistical models and their role in compositing, and related topics.

SOIL

REFER ALSO TO CITATION(S) 54715, 54720, 55849, 55872

55858 (ORNL-tr—4642) **Retention and accumulation of ^{106}Ru + ^{106}Rh in various soil samples.** Bovard, P.; Grauby, A.; Boyer, J. (Commissariat a l'Energie Atomique, Brussels (Belgium); Centre de Recherches et d'Experiences du Genie Rural, Brussels (Belgium)). [nd]. Translation by S.D. Blalock Jr. of Belgian report. (CONF-621010—1). 10p. Dep. NTIS, PC A02/MF A01.

From Symposium on the retention and migration of radioactive ions in soils; Saclay, France (16 Oct 1962).

Ruthenium migration has been studied in three types of soils: silt; podzol; and compost. Successively the effects of permeability and of exchange potentials in radioisotope fixation have been shown. Exchange potential is not sufficient to explain soil behavior. Absorption indeed seems clearly to depend on exchange capacity but other factors should be taken into account. Lixiviation tests have been made on the three soil types. The results show that a small part of the fixed ions is swiftly transported but that the major portion seems to be strongly fixed. The results obtained thus far correspond to given working conditions. The authors intend to carry on their work by modifying other parameters, soil moisture in particular.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 54353, 55309, 55318

55859 (NP—23146) **Land capability model for the lower Lake Monroe watershed. Technical report No. 66.** Chiesa, J.R.; Roberts, M.C.; Randolph, J.C.; Howe, R.S. (Indiana Univ., West Lafayette (USA). Water Resources Research Center; Purdue Univ., Lafayette, IN (USA). Water Resources Research Center). Jul 1975. 27p. Indiana Univ., West Lafayette.

The purpose of this study is to develop a preliminary land-use capability model for a 100 square mile area surrounding Lake Monroe, a 10,750-acre reservoir in south central Indiana. This study can be viewed as an extension of the Lake Monroe Land Suitability Study (1975) which provides land-use, geological, and ecological inventories for the Lake Monroe area. A second goal of the present study is to develop a user-oriented interactive computer program which will make both the inventory and the model output available to planners, prospective developers, and other interested citizens. The Lake Monroe study describes the area's geology, terrestrial and aquatic ecology, current land use, and the institutional framework determining political and legal jurisdiction over the area. The significance of the various types of data with reference to land-use considerations is discussed.

55860 Reclaiming surface mined land in west Kentucky. Powell, J. (Peabody Coal Co., Central City, KY); Barnhisel, R.I. pp 28p, Set No. 3, Paper 2 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

All land reclamation projects should have the common initial objective of stabilizing the land to prevent erosion. The second phase should be the consideration of placing the reclaimed land into the highest possible potential land use category so the reclaimed land can become an economic asset rather than a liability. The establishment of the initial vegetative cover is not as difficult as maintaining that stand. The maintenance of a long-term vegetative cover is what makes the process of reclaiming surface-mined land a complex operation. Factors that should be considered in planning an effective long-term reclamation program include climate, spoil testing, plant species selection, final grading, fertilizer and lime amendments, seedbed preparation, mechanics of seeding, and management of newly-seeded areas. Poor planning or incorrect choices, as well as failure to properly complete any one of the above, could result in total or partial failure of the reclamation project. All of these factors are equally important, and it is difficult to discuss them in a chronological order because their effects upon ultimate vegetation establishment are interrelated. However, a brief presentation on each factor or combination of factors is presented as they are related to a revegetation program.

REGULATIONS

REFER ALSO TO CITATION(S) 54356, 55231

55861 Concerns for multiple use on Federal lands. Melcher, J. (Senate, Washington, DC). pp 5p, Set No. 1, Paper 3 of 1977 mining convention of the American Mining Congress. Session papers. Washington, DC; American Mining Congress (1977).

From Mining convention; San Francisco, CA, USA (11 Sep 1977).

Passage of the Federal Land Policy and Management Act (FLPMA) of 1976 was long needed; it reaffirmed Congressional intent of multiple use management. FLPMA represents a "codification" of much of what the Bureau of Land Management (BLM) has been doing for years. Significant new workloads were created; deadlines established for both old and new functions. The Act replaces many of the 2,500 laws pertaining to public land management, and contains 57 sections and innumerable provisions that must be dealt with in the implementation process. Some provisions call for simple actions, but the majority call for lengthy rulemaking and require extensive public participation. Consequently, it will take perhaps five to 10 years to fully implement the new law. Provisions of the Act will eventually affect nearly every phase of BLM operation. They establish goals and guidelines for inventory and identification of natural and cultural resources; land use planning; management of public lands and their resources; grazing fees, leases and permits, management of wild horses and burros; a comprehensive wilderness study, and various and other BLM activities in resource management.

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 55899, 55958

55862 (CONF-7605172—) **Symposium on ecology and management of the continental shelf.** (Ecological Society of America, Olympia, WA; American Society of Limnology and Oceanography, Ann Arbor, MI; Council on Environmental Quality, Washington, DC (USA)). 1976. 351p. TIC.

From Symposium on ecology and management of the continental shelf; New Orleans, LA, USA (31 May 1976).

Six papers discuss the history of research in marine biology and the development of mathematical models of continental shelf ecosystems. Details of studies of carbon flow analysis of the Ross Sea, Antarctica, pellagic ecosystem; coastal upwelling of nutrients associated with the slow flow of the California, Humbolt, Canary, and Benguela Currents of the Pacific Ocean; the ecology of the Hawaiian continental shelf; the Southeastern Atlantic continental shelf; and the ecology and management of coral reefs and organic banks of the southern Atlantic and Gulf of Mexico continental shelf.

55863 (COO—4706-2) **Distribution of marine birds on Georges Bank and Adjacent waters. Progress report No. 2, April—June 1978.** Powers, K.D. (Manomet Bird Observatory, MA (USA)). Jul 1978. Contract EE-78-S-02-4706. 218p. Dep. NTIS, MF A01.

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From 27 March to 20 June 1978, 7 cruises aboard U.S. Coast Guard cutters DECISIVE, VIGILANT, and VIGOROUS and the National Marine Fisheries Service research vessel ALBATROSS IV were made on outer continental shelf waters in regions from the mid-Atlantic to the Gulf of Maine and Scotian Shelf. A total of 13916 marine birds of at least 27 species were counted in 711.16 km^2 sampled from 730 fixed-area transects (300m wide by 10 minutes cruising time). An equal number of 10-minute total bird counts (no fixed area) were conducted at the same time. All of MBO cruises conducted in 1978 have been transcribed onto computer data sheets and were proofed and verified. Seven of 24 MBO cruises made in 1977 have been transcribed. U.S. Fish and Wildlife Service Migratory Bird and Habitat Research Laboratory will keypunch the data. From a review of over 100 scientific papers and books, food habits of fulmars, shearwaters, storm-petrels, gannets, gulls, and alcids were referenced by bird species and author.

55864 (ORNL/NUREG/TM—222) **Aspects of the winter predator—prey relationship between sauger and threadfin shad in Watts Bar Reservoir, Tennessee.** McGee, M.V.; Griffith, J.S.; McLean, R.B. (Oak Ridge National Lab., TN (USA)). 1 Apr 1978. Contract W-7405-ENG-26. 73p. (NUREG/CR—0170). Dep. NTIS, PC A04/MF A01.

This study sought to determine the impact of cold-induced mortality and impingement of threadfin shad (Dorsoma petenense) on the food consumption and prey selection of sauger (Stizostedion canadense), and to estimate the ability of sauger to digest meals consumed at low temperatures in winter. Prey selection of sauger was monitored from November 1976 through April 1977. Stomach contents of 536 sauger indicated threadfin provided the entire forage base for sauger through January. Food consumption of sauger was reduced and prey selection shifted to other species after January due to the combined effects of predation, impingement, and natural mortality of cold-stressed threadfin. Threadfin shad of a size available to most sauger were virtually eliminated by February. From February through April some sauger utilized alternate prey species. Laboratory digestion rate studies of sauger indicated digestion of force-fed meals of 4 to 7 g fathead minnows (Pimephales promelas) could proceed to 90 percent completion in 54 h at 5 C, 47 hr at 10 C, and 25 hr at 15 C. Conclusions of this study are: (1) that threadfin shad were the most abundant and vulnerable prey species available to and utilized by sauger during the late fall and winter months; (2) extensive mortalities of threadfin due to cold-stress increased sauger predation on four alternate prey species; (3) sauger continued feeding and digesting meals at temperatures between 5 and 15 C every 1 to 3 days; (4) sauger stored excess energy available from threadfin early in the winter as visceral fat which was available later when food consumption was reduced.

55865 Physical, chemical, and biological factors in the initiation and destruction of biogenic meromixis in a soft-water lake. Culver, D.A. *Int. Ver. Theor. Angew. Limnol., Verh.;* **19**: 776-783(Oct 1975).

Studies were made of a lake during a meromictic and a holomictic phase so that comparisons could be made while morphometric and watershed factors remained invariant. Data indicate that chemical resistance to mixing of the monimolimnion is less important than the magnitude of downwelling currents from the surface. Meromixis can be destroyed by silty inflows, but the effect of nutrient loading on algal productivity and thus transparency and summer heat income, can decrease autumnal circulation enough to prevent complete overturn.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 54277, 54882, 55836, 55849, 55872, 55918, 55921

55866 (AD-A—049921) **Feasibility study of response techniques for discharges of hazardous chemicals that float on water. Final report.** Greer, J.S. (MSA Research Corp., Evans City, PA (USA)). Oct 1976. Contract DOT-CG-51870-A. 228p. (MSAR—76-125). NTIS PC A11/MF A01.

An in depth evaluation was conducted of potential response techniques for ameliorating the vapor hazard from discharges of hazardous chemicals that float on water. Fifteen techniques were selected on the basis of their performance in similar situations, such as oil spills and hazardous chemical production or handling. Six of these techniques were judged to be feasible methods for achieving

the objectives of this program. Vaporization rate reduction, the objective of Task I, could be achieved by using surfactant films, foams, or sorbents. Vapor concentration reduction, the objective of Task II, could be achieved by encapsulation. Vapor flammability reduction, the objective of Task III, could be achieved by using foams and water aerosols. Techniques utilizing particulate cover, foamed-in-place urethane layer, gels, and cryogenic cooling were defined as having potential for successful utilization. All techniques were judged to need some further development or assessment. Recommendations for specific programs are presented.

55867 (BNWL-SA—6488) **Current deposition of kepone residuals in the Hopewell, Virginia area.** Shupe, S.J.; Dawson, G.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1977. Contract EY-76-C-6-1830. 20p. (CONF-7709144—1). Dep. NTIS, PC A02/MF A01.

From 2. Chesapeake Bay kepone conference; Easton, MD, USA (21 Sep 1977).

The exact amount of kepone released into the environment since production begin in Hopewell, Virginia, in 1966 is not known. It has been estimated, however, that roughly one hundred thousand pounds of the chemical were released during the period 1966 to 1975 from the Allied Chemical Corporation semi-works plant and the Life Sciences Products Company. This total resulted from the continuous release of kepone-saturated wastewaters, particulate emissions, and bulk disposal of waste batches of the chemical. In April 1977 a study was initiated to determine the feasibility of removing kepone from the James River. One aspect of this research involved a field sampling program designed to establish the extent of kepone deposition in and around the City of Hopewell. Emphasis was placed on identifying specific areas of high kepone concentration which could potentially serve as continuing sources of contamination to the James River system. This paper presents a summary of the data collected during 1977 over five months of the sampling program.

55868 **Crankcase oils: are they a major mutagenic burden in the aquatic environment.** Payne, J.F. (Newfoundland Biological Station, St. John's); Martins, I.; Rahimtula, A. *Science;* **200**: No. 4339, 329-330(21 Apr 1978).

Fractions from used crankcase oil enriched in polyaromatic hydrocarbons induced revertant colonies in Salmonella typhimurium strain TA 98 when activated by rat or trout liver extracts. The mutagenic activity was not due to benzopyrene or benzanthracene. Fractions from various crude and refined petroleums were nonmutagenic. Among various petroleum hydrocarbons entering inland and coastal waters, used crankcase oils may represent a major mutagenic burden.

55869 (NTIS/PS—78/0043) **Biodeterioration of oil spills (a bibliography with abstracts). Report for 1964—January 1978.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Jan 1978. 123p. NTIS PC N01/MF N01.

The selected abstracts report on algae, bacteria, hydrocarbons, petroleum degradation, oil spills, beach cleanups, and microbial degradation as related to biodeterioration of oil spills.

55870 (NTIS/PS—78/0143) **Ground water pollution (citations from the American Petroleum Institute data base). Report for 1964—January 1978.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Feb 1978. 134p. NTIS PC N01/MF N01.

The bibliography contains abstracts of worldwide research on the contamination of ground water, especially from petroleum and petrochemical sources. Causes, phenomena, prevention, control, and analysis are among the subjects covered.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 54718

55871 (BNWL-SA—6244) **Migration of plutonium from freshwater ecosystem at Hanford.** Emery, R.M.; Klopfer, D.C.; McShane, M.C. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1977. Contract EY-76-C-06-1830. 44p. Dep. NTIS, PC A03/MF A01.

A reprocessing waste pond at Hanford has been inventoried to determine quantities of plutonium (Pu) that have been accumulated since its formation in 1944. Expressions of export were developed from these inventory data and from informed assumptions about the vectors which act to mobilize material containing Pu. This 14-acre pond provides a realistic illustration of the mobility of Pu in a lentic ecosystem. The ecological behavior of Pu in this pond is similar to that in other contaminated aquatic systems having widely differing limnological characteristics. Since its creation, this pond has received about one Ci of ^{239,240}Pu and ^{238}Pu, most of which has been retained by its sediments. Submerged plants, mainly diatoms and Potamogeton, accumulate >95% of the Pu contained in biota. Emergent insects are the only direct biological route of export, mobilizing about 5 x 10^3 nCi of Pu annually, which is also the estimated maximum quantity of the Pu exported by waterfowl, birds and mammals collectively. There is no apparent significant export by wind, and it is not likely that Pu has migrated to the ground water below U-Pond via percolation. Although this pond has a rapid flushing rate, a eutrophic nutrient supply with a diverse biotic profile, and interacts with an active terrestrial environment, it appears to effectively bind Pu and prevent it from entering pathways to man and other life.

WATER

REFER ALSO TO CITATION(S) 54720, 54949, 55847, 55849

55872 (PNL—2569) **Sequim Marine Research Laboratory routine environmental measurements during CY-1977.** Fix, J.J.; Blumer, P.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1978. Contract EY-76-C-06-1830. 27p. Dep. NTIS, PC A03/MF A01.

Beginning in 1976, a routine environmental program was established at the Marine Research Laboratory (MRL) at Sequim, Washington. The program is intended to demonstrate the negligible impact of current MRL operations on the surrounding environs and to provide baseline data through which any cumulative impact could be detected. The sampling frequency is greater during the first 2 years of the program to provide sufficient initial information to allow reliable estimates of observed radionuclide concentrations and to construct a long-term sampling program. The program is designed, primarily, to determine levels of radioactivity present in selected biota in Sequim Bay. The biota were selected because of their presence near the laboratory and their capacity to concentrate trace elements. Other samples were obtained to determine the radionuclides in Sequim Bay and laboratory drinking water, as well as the ambient radiation exposure levels and surface deposition of fallout radionuclides for the laboratory area. Appendix A provides a summary of the analytical methods used. The present document includes data obtained during CY 1977 in addition to CY-1976 data published previously.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 55872

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 55916, 55917, 55918, 55925

55873 (ANL/EES-CP—13) **Observation of thermal plumes from submerged discharges in the Great Lakes and their implications for modeling and monitoring.** Ditmars, J.D.; Paddock, R.A.; Frigo, A.A. (Argonne National Lab., IL (USA)). 1977. Contract W-31-109-ENG-38. 24p. (CONF-770516—11). Dep. NTIS, PC A02/MF A01.

From Conference on waste heat management and utilization; Miami Beach, FL, USA (9 May 1977).

Measurements of thermal plumes from submerged discharges of power plant cooling waters into the Great Lakes provide the opportunity to view the mixing processes at prototype scales and to observe the effects of the ambient environment on those processes. Examples of thermal plume behavior in Great Lakes' ambient environments are presented to demonstrate the importance of measurements of the detailed structure of the ambient environment, as well as of the plumes, for interpretation of prototype data for modeling and monitoring purposes. The examples are drawn from studies by Argonne National Laboratory (ANL) at the Zion Nuclear Power-Station and the D. C. Cook Nuclear Plant on Lake Michigan and at the J. A. FitzPatrick Nuclear Power Plant on Lake Ontario. These studies included measurements of water temperatures from a moving boat which provide a quasi-synoptic view of the three-dimensional temperature structure of the thermal plume and ambient water environment. Additional measurements of water velocities, which are made with continuously recording, moored, and profiling current meters, and of wind provide data on the detailed structure of the ambient environment. The detailed structure of the ambient environment, in terms of current, current shear, variable winds, and temperature stratification, often influence greatly thermal plume behavior. Although predictive model techniques and monitoring objectives often ignore the detailed aspects of the ambient environment, useful interpretation of prototype data for model evaluation or calibration and monitoring purposes requires detailed measurement of the ambient environment. Examination of prototype thermal plume data indicates that, in several instances, attention to only the

gross characteristics of the ambient environment can be misleading and could result in significant errors in model calibration and extrapolation of data bases gathered in monitoring observations.

55874 (NTIS/PS—78/0171) **Thermal pollution. Part 1. Control techniques and general studies (a bibliography with abstracts). Report for 1964-Feb 78.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 211p. NTIS PC N01/MF N01.

Reports concerned with control techniques for heated effluents from power and industrial plants are cited. Also included are studies on general thermal pollution problems and their abatement. Many reports on the remote sensing of thermal effluents are also cited. However, the control of thermal pollution by using the waste heat for constructive purposes is not covered in this bibliography.

55875 (NTIS/PS—78/0173) **Thermal pollution. Part 3. Hydrology and hydrodynamics (a bibliography with abstracts). Report for 1964-Feb 78.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 218p. NTIS PC N01/MF N01.

Aspects of the hydrology and hydrodynamics of heated effluents are covered in the bibliography, including mixing, diffusion, modeling, heat transfer, and flow.

55876 (ORNL/TM—5578) **Two-dimensional transient far-field analysis for the excess temperature from an arbitrary source.** Witten, A.J.; Long, E.C. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 48p. Dep. NTIS, PC A03/MF A01.

An analytic solution is presented for the two-dimensional time-dependent advective diffusion equation governing the distribution of excess temperature in a river of uniform width, depth, and downstream flow. The solution is also applicable to a straight coastline with uniform longshore flow. Exact solutions are obtained for a point heat source and a particular line heat source, while an approximate representation is given for an arbitrary time-varying heat source. These solutions are incorporated into a computer program which calculates excess temperature and time rate-of-change of excess temperature in a river or coast as a result of waste heat discharged from various transient sources.

55877 (SRO—757-7) **Effects of heated water on the development of gametes in the bluegill sunfish, Lepomis macrochirus.** Graser, L.F. (Georgia Univ., Athens (USA)). 1977. Contract EY-76-S-05-0757. Pp. Dep. NTIS, PC A03/MF A01.

Gamete development was examined histologically in 10 bluegill populations, each with a distinctly different thermal history. Water temperature for the first group studied was dictated by the seasonal temperature changes of the 2.6 hectare pond near Athens, Georgia, from where it was collected. The second population was collected from a nuclear cooling reservoir which is elevated at least 6 to 8°C above temperature considered natural for the latitude. The eight additional populations examined were maintained at controlled water temperatures that were above the ambient temperatures of the natural ponds in northcentral Georgia. Accelerated gametogenesis can occur in bluegill subjected to high water temperature and short but slowly increasing photoperiod. Gonad proportioning equations do not accurately depict true gonad condition in some male bluegill exposed to high water temperatures. Mature ova size can be reduced in female bluegill exposed to high water temperature. Mature bluegill can occur year-round under abnormally high water temperature conditions.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 54883, 55315, 55859, 55863, 55864, 55873

REGULATIONS

REFER ALSO TO CITATION(S) 54526, 55231

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 55224

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 54630, 54713, 54942, 55219, 55225, 55226, 55227, 55248, 55836

55878 **Mankind - energy - technology.** Zischka, A. *Elektrowaerme Int., Ed. A;* 36: No. 1, 61-65(Jan 1978). (In German).

The significance of energy for economic growth and prosperity is today greater than ever. Our civilization is based on the energy resources of our planet and their utilization. Technology enables us to change over from the present consumption of energy to an energy cycle. The progress of civilization is not endangered by limited resources of energy or technological limitations but by the growing bias which society has recently been displaying towards the achievements of engineers, scientists, and industry. This attitude can however, be expected to disappear in time.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 55308, 55878

55879 (DOE/EV—0025) **Office of Environment. Statement of programs: FY 1979.** (Department of Energy, Washington, DC (USA). Office of Planning Coordination). Jul 1978. 37p. Dep. NTIS, PC A03/MF A01.

Meeting our energy needs and protecting the quality of our environment are complementary parts of our national energy planning. The search for energy supplies and the development of new energy sources must go hand-in-hand with clean air, clean water, and a healthy environment. The Office of Environment (EV) has a major responsibility in the Department of Energy (DOE) for assuring that environmental concern are translated into environmental programs and commitments. EV studies the environmental, health and safety effects of all DOE energy programs, overviews the environmental aspects of these programs, and ensures their consistency with environmental and safety laws, regulations, and policies. EV programs support the Department's efforts to achieve the best balance between energy availability and environmental acceptability. This document briefly describes EV activities, summarizes programs for FY 1979, and identifies responsible divisions and offices. Included are funding levels and budgetary trends for EV programs and the energy technologies they support, as well as institutions responsible for performing the EV activities.

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 54567, 55103

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

55880 **Range extension of Pardosa lapidicina emerton (Araneida: Lycosidae) to Georgia.** Nabholz, J.V.; Reynolds, L.J.; Crossley, D.A. Jr. (Univ. of Georgia, Athens). *J. Ga. Entomol. Soc.;* 12: No. 3, 241-243(Jul 1977).

Collections of the spider, Pardosa lapidicina, were made at four granite or gneiss rock outcrops in north-central Georgia. The absence of this spider in the adjacent woodland demonstrated a strong preference for the rock outcrop habitat by this species. Measurement of population density was difficult because of the behavior of this species. They can withstand the heat of the sun for a short time only and frequently get under stones for shade. (HLW)

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 55836, 55892, 55894

55881 (COO—2725-03) **Repair of DNA treated with γ-irradiation and chemical carcinogens. Comprehensive report of entire period of ERDA support from June 1, 1975—January 15, 1978.** Goldthwait, D.A. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Biochemistry). 1978. Contract EY-76-S-02-2725. 16p. Dep. NTIS, PC A02/MF A01.

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A partially purified enzyme fraction isolated from E. coli showed an N-glycosidase activity as well as a phosphodiesterase activity on DNA treated with methylnitrosourea, and with 7-bromomethylbenz(a)anthracene and a phosphodiesterase activity against γ-irradiated DNA. Both 0-6 methyl guanine and 3-methyladenine were released from DNA treated with MNU; the adenine and guanine derivatives from the DNA treated with 7-bromomethyl-12-methylbenz(a)anthracene were also liberated. Progress is also reported on studies on Endonucleases II and VI and Exonuclease III of E. coli; methods for assay and for synthesis of substrates; attempts at purification of repair enzymes from mammalian tissues; and β-propiolactone reactions with deoxynucleosides and with DNA.

55882 (COO—3225-35) **Enzymatic studies of radiation damage. Progress report, 1977—1978 including the summary for the triennium, 1975—1978.** Laskowski, M. Sr. (Roswell Park Memorial Inst., Buffalo, NY (USA)). 1978. Contract EY-76-S-02-3225. 19p. Dep. NTIS, PC A02/MF A01.

It was recently found that venom phosphodiesterase has properties of single-strand specific enzymes; it cleaves circular superhelical DNA and produces a full-length linear DNA (form III) plus a number of discrete bands of fragmented double-stranded DNA. The cleavages that lead to these fragments occur in pairs. Each pair accounts for the total length of the genome. Mapping of fragments showed that 4 out of 5 susceptible sites corresponded to previously established early denaturation sites. Single-strand specific enzymes were studied wich chromatin (chicken erythrocytes) as substrate. Chromatin is reluctantly digested to products of very high molecular weight ranging from 30 to 100 S with an average of about 60 S. Further digestion of these products with micrococcal nuclease leads to nucleosomes suggesting that nucleosomes remain preserved.

55883 (COO—3419-19) **Studies on virus-induced cell fusion. Progress report, August 1, 1977—June 30, 1978.** Person, S. (Pennsylvania State Univ., University Park (USA)). Jul 1978. Contract EY-76-S-02-3419. 12p. Dep. NTIS, PC A02/MF A01.

We have previously postulated that wild-type Herpes Simplex Virus type I (HSV-1) infections are characterized by the presence of a fusion factor and a fusion inhibitor activity. The fusion inhibitor presumably is dominant so that a small fraction of cells fuse in a typical wild-type infection. Furthermore, the syn mutants isolated in our laboratory are thought to cause extensive cell fusion because the production of active fusion inhibitor in cell membranes is delayed. If mutations existed that altered both the fusion factor and fusion inhibitor activity then separate viruses containing these two mutations might be able to complement each other, each supplying the defective gene product missing in the other virus. This would produce a wild type and not a syncytial mutant response. Complementation tests between two viruses, tsB5 and syn 20, which are thought to contain defects in the production of active fusion factor and fusion inhibitor activity, respectively, were done. A wild-type response was observed indicating that the mutations affecting fusion were in two separate genes.

55884 (LA-UR—78-1655) **Status of solid-phase enzyme immunoassays.** Saunders, G.C. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 33p. (CONF-780821—1). Dep. NTIS, MF A01.

From 4. conference in clinical laboratory medicine; Aspen, CO, USA (23 Aug 1978).

Portions of document are illegible.

Solid-phase enzyme immunoassays are becoming increasingly popular due to their sensitivity, simplicity, and versatility. The three most common types of these assays (indirect, double-antibody, and competitive binding) have been described and examples given of their use. Short discussions of various aspects of the "art" of performing solid-phase EIAs have been included. Finally, a brief overview of the Technicon automated EIA processor has been presented.

55885 (SRO—644-18) **Study of non-histone proteins of the nucleolochromatin complex. Progress report, July 1977—April 1978.** Patel, G.L. (Georgia Univ., Athens (USA). Dept. of Zoology). Apr 1978. Contract EY-76-S-09-0644. 18p. Dep. NTIS, PC A02/MF A01.

Progress is reported on the purification of a eukaryotic DNA-unwinding protein from rat liver and its characterization and studies on its interaction with a synthetic DNA. An antibody against this protein and results are reported from in vivo studies elucidate its biological role.

55886 **Another flame retardant, tris-(1,3-dichloro-2-propyl)-phosphate, and its expected metabolites are mutagens.** Gold, M.D.; Blum, A.; Ames, B.N. (Univ. of California, Berkeley). *Science;* **200**: No. 4343, 785-787(19 May 1978).

A flame retardant used in children's sleepwear, tris-(1,3-dichloro-2-propyl)phosphate (Fyrol FR2) is a mutagen in the Salmonella-mammalian tissue homogenate test after it has been activated by mouse or rat liver homogenate. The expected enzymatic hydrolysis product, 1,3-dichloro-2-propanol, is similarly a mutagen after activation by liver homogenate. A proposed metabolite of the flame retardant, 1,3-dichloro-2-propanone, is a potent mutagen in the absence of such activation. A flame retardant with similar structure, tris-(2,3-dibromopropyl)phosphate (tris-BP), was shown previously to be a mutagen, to cause sterility in animals, to be a carcinogen, and to be absorbed through human skin. These and other flame retardants have characteristic nuclear magnetic resonance spectra that can be used to determine which flame retardant is present in commercially purchased sleepwear. Sleepwear treated with tris-BP, Fyrol FR2, and other chemical additives was being sold in late 1977.

55887 **Δ9-tetrahydrocannabinol and 17β-estradiol bind to different macromolecules in estrogen target tissues.** Okey, A.B.; Bondy, G.P. (Univ. of Windsor, Ont.). *Science;* **200**: No. 4339, 312-314(21 Apr 1978).

DELTA⁹-Tetrahydrocannabinol (DELTA⁹-THC), added to the limit of its solubility, did not compete with tritiated 17 beta-estradiol for binding to estrogen receptor sites in mouse mammary or uterine cytosols. On sucrose density gradients of low-ionic strength, mammary cytosol labeled with [^{3}H]estradiol exhibited a binding peak near the "8S" region typical of estrogen receptor whereas in cytosol labeled with DELTA⁹-[^{3}H]THC binding was limited to the nonspecific 4- to 5S region. Differences in sedimentation properties and reciprocal competition studies strongly refute previous claims that DELTA⁹-THC binds to estrogen receptor and that by so doing it directly acts as an estrogen.

55888 **Effect of proflavine plus visible light on the DNA of human cells.** Regan, J.D.; Setlow, R.B. (Oak Ridge National Lab., TN). *Photochem. Photobiol.;* **25**: 345-346(1977).

Cultures of human skin fibroblasts were labeled with tritiated thymidine and treated with proflavine sulfate. Some of the cultures were irradiated with light from blue fluorescent lamps in the range of 390 to 530 nm. Observations were made on sedimentation profiles of DNA and the molecular weight of DNA. No effect was observed on cultures treated with proflavine alone. Strand breaks were induced in DNA in cultures treated with both proflavine and light; the breaks were repaired 2 h after irradiation. The molecular weight of DNA was reduced in cultures treated with both proflavine and light. The significance of the results for therapy of herpes infection is discussed. (HLW)

55889 **Simultaneous peptide and oligonucleotide formation in mixtures of amino acid, nucleoside triphosphate, imidazole, and magnesium ion.** Weber, A.L.; Caroon, J.M.; Warden, J.T.; Lemmon, R.M.; Calvin, M. (Lawrence Berkeley Lab., CA). *BioSystems;* **8**: 277-286(1977).

Simultaneous peptide and oligonucleotide formation was observed in reaction mixtures of amino acid, nucleoside triphosphate, imidazole, and $MgCl_2$. At 70°C in solutions that were evaporated to dryness the formation of peptide for phe and pro was greatest with CTP relative to ATP, GTP, and UTP. Lysine exhibited a preference for GTP and glycine for UTP. At ambient temperature in solution at pH 7.8, CTP was preferred by glycine, but at pH 8.7 UTP was preferred. The glycine nucleotide phosphoramidates were also detected and characterized in reactions at 40°C. The glycine-reaction preference for CTP at pH 7.8 and UTP at 8.7 suggested that the basicity of the nucleoside triphosphate was involved in increasing the peptide yield. CTP near neutrality is the most basic nucleoside triphosphate and the basic anionic form UTP could facilitate peptide formation at pH 8.7. These data, together with information on the complexing of poly(C) by GTP, led to the experimentally approachable hypothesis that GTP, by forming a basic triplex between the cytosine residues adjacent to the peptidyl adenosine and aminoacyl adenosine at the termini of two proto-tRNAs, would promote peptide bond synthesis between the aminoacyl residue and peptidyl residue.

55890 **tRNA methyltransferases in Escherichia coli during methionine starvation.** Shugart, L.; Chastain, B. (Oak Ridge National Lab., TN). *FEMS Microbiol. Lett.;* **2**: 11-14(1977).

Results show that during anion-exchange column chromatography the elution characteristics of several enzyme activities associated with the maturation of tRNA and the aminoacylation of this molecule for protein synthesis are changed in cell preparations where there is undermodified tRNA. It is felt that the observed change in the chromatographic properties of these macromolecules between cell extracts is the result of a stable rather than a transitory interaction of specific proteins and nucleic acids. However, this has not been unequivocally shown, and the data presented here could be the result of an artifact generated by the isolation method employed. This report has demonstrated that several enzyme activities associated with tRNA maturation are extractable from cells after an extended period of unfavorable culture conditions during which a large amount of undermodified tRNA has been synthesized. Whether or not this tRNA forms complexes with these enzymes, thus

providing a protective and stabilizing environment, is not known, but it is suggested by the data presented. Similar complexes have recently been reported in eukaryotic cells.

CYTOLOGY

REFER ALSO TO CITATION(S) 55906

55891 (UCRL-Trans—11381) **Karyotype of Muntiacus muntjak vaginalis.** Shih, L.N. Translated from *Tung Wu Hsueh Pao;* **22**: No. 1, 116(1976). 4p. Dep. NTIS, PC A02/MF A01.

The muntjac (Muntiacus muntjak vaginalis, Boddaert) has the fewest chromosomes of any mammal known today. The special characteristics of its karyotype are: (1) small number of chromosomes; (2) large, especially long chromosomes; and (3) chromosome pairs with distinct, individual shapes that can be accurately counted in routine procedures using stains. Thus in testing biological research such as in cellular biology and cellular radiation inheritance work, the muntjac deserves recommendation as a new, experimental animal. The convenient method of peripheral blood culture was employed to examine the karyotype of a male muntjac from the Yuan-t'ung Zoo in K'un-ming which had been captured in the Ssu-mao District. The method and some results are described.

GENETICS

REFER ALSO TO CITATION(S) 55891

55892 (UR—3490/LCP-10) **Studies on a mutant regulatory protein synthesized by gene 45 of bacteriophage T4D: differential functional stabilization and suppression of temperature-sensitive characteristics.** Baser, B.R. (Rochester Univ., NY (USA). School of Medicine and Dentistry). 1978. Contract EY-76-C-02-3490. 208p. Dep. NTIS, PC A10/MF A01.

Thesis.

Bacteriophage T4 diverts host cell metabolism from bacterial to viral functions after infection. The pattern is one of total, rapid, and irreversible host genome inactivation and degradation, and involves time-ordered sequences of gene expression generated by both transcriptional and posttranscriptional regulation. E. coli B infected with wild-type T4 at 37°C synthesizes early proteins until about 12 min post-infection (mpi); this is called the S1 shutoff. When DNA synthesis is blocked by mutation, early protein synthesis continues to roughly 22 mpi; this shutoff (S2) is controlled by regA function. An understanding of the controls operating on and through bacteriophage P45 to regulate DNA synthesis and late transcription is therefore central to the understanding of late protein production and viral maturation.

55893 **Comparison of heat and interchromosomal effects on recombination and interference in Drosophila melanogaster.** Grell, R.F. (Oak Ridge National Lab., TN). *Genetics;* **89**: No. 1, 65-77(May 1978).

Heat and interchromosomal effects on recombination have been compared for 23 regions comprising the predominantly euchromatic portions of the five arms of the Drosophila genome. Patterns of response are strikingly similar, with both modifiers causing proximal and distal increases and minimal effects in the middle of the arms. Changes in interference for the same regions in the presence of the two modifiers reveal little similarity, except for the X chromosome. The question of independent control of interference and recombination, as well as alternatives for their temporal sequence, is discussed. Recombination response to the two modifiers in the centric heterochromatin of chromosome 2 is markedly different from that found in euchromatin. The interchromosomal effect is absent here, whereas heat induces an increase roughly an order of magnitude greater than that found in euchromatin and totally unlike the lack of response in the proximal heterochromatin of the X chromosome. It is proposed that the sequestering of DNA satellite I (thermal dissociation 9 to 20° lower than that of the other major satellites) in the centromeric heterochromatin of chromosome 2 (but not in X or 3) may account for the increase.

55894 **Image analysis, flow fluorometry and flow sorting of mammalian chromosomes.** Mendelsohn, M.L.; Carrano, A.V.; Gray, J.W.; Mayall, B.H.; Van Dilla, M.A. (Univ. of California, Livermore). pp 191-204 of Molecular biology of the mammalian genetic apparatus. Amsterdam; Elsevier North-Holland Biomedical Press (1977).

As the major packaging units of genetic material, chromosomes have broad relevance to basic and applied genetics, to clinical medicine and to public health. The traditional morphological approach to the mammalian chromosome is a subjective, non-quantitative and essentially non-molecular biological approach. The thrust of the Livermore effort in chromosomology is to emphasize the physical and chemical characterization of the chromosome by developing and using appropriate instruments to quantitate the DNA in individual mammalian chromosomes, to process chromosomes rapidly and precisely and to purify chromosomes for subsequent chemical and biological applications. Progress in these areas has been rapid and exciting in the past few years, and this chapter will attempt to summarize that part of the work that bears on the molecular biology of the mammalian genetic apparatus. We have approached the measurement and manipulation of chromosomes with two very different techniques. The first is absorption cytophotometry coupled to image analysis, a method which measures relative DNA content and centromere index of preidentified chromosomes within the well flattened metaphase cell on a microscope slide. The second is flow fluorometry and sorting, a technique which requires chromosomes in suspension, measures relative DNA content and sorts or separates chromosomes within specified ranges of DNA content. The image-analytic approach uses traditional preparations and can be directly coupled to traditional analysis; as presently practiced it is slow but immediately applicable to human cytogenetics. The flow fluorometric approach uses non-conventional preparations and a non-conventional chromosomal rather than cellular framework for the analysis; it is extremely rapid, unique in its ability to purify chromosomes, and potentially but not immediately applicable to clinical cytogenetics.

METABOLISM

REFER ALSO TO CITATION(S) 55864, 55887

55895 **Limitations and potentials for biological nitrogen fixation in the tropics.** Doebereiner, J.; Burris, R.H.; Hollaender, A.; Franco, A.A.; Neyra, C.A.; Scott, D.B. New York; Plenum Press (1978). 411p. (CONF-770759—).

From Conference on limitations and potentials for biological nitrogen fixation in the tropics; Brasilia, Brazil (18 Jul 1977).

Twenty-two papers on various aspects of nitrogen fixation in tropical plants are presented. (HLW)

MEDICINE

REFER ALSO TO CITATION(S) 55836, 55905

55896 (LA-UR—78-1827) **Proton computed tomography.** Hanson, K.M. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 11p. (CONF-780830—1). Dep. NTIS, PC A02/MF A01.

From Conference on computer aided tomography and ultrasonics; Haifa, Israel (Aug 1978).

The use of protons or other heavy charged particles instead of x rays in computed tomography (CT) is explored. The results of an experimental implementation of proton CT are presented. High quality CT reconstructions are obtained at an average dose reduction factor compared with an EMI 5005 x-ray scanner of 10:1 for a 30-cm-diameter phantom and 3.5:1 for a 20-cm diameter. The spatial resolution is limited by multiple Coulomb scattering to about 3.7 mm FWHM. Further studies are planned in which proton and x-ray images of fresh human specimens will be compared. Design considerations indicate that a clinically useful proton CT scanner is eminently feasible.

55897 (NTIS/PS—78/0092) **Computerized axial tomography (citations from the ntis data base). Report for 1964—January 1978.** Crockett, P.W. (National Technical Information Service, Springfield, VA (USA)). Feb 1978. 67p. NTIS PC N01/MF N01.

The bibliography is a compilation of Federally-funded research citations on the following topics on computerized axial tomography technology: criteria and standards for need assessment; guidelines for services planning; cost-benefit analysis; equipment and operation; and impact on medical diagnosis. (This updated bibliography contains 62 abstracts, 30 of which are new entries to the previous edition.)

55898 (NTIS/PS—78/0093) **Computerized axial tomography (citations from the Engineering Index data base). Report for 1970—February 1978.** Crockett, P.W. (National Technical Information Service, Springfield, VA (USA)). Feb 1978. 64p. NTIS PC N01/MF N01.

A compilation of references from worldwide literature is presented on mathematical image reconstruction methods, algorithms, electronic equipment, and display systems used in the technology of computerized axial tomography. (This updated bibliography contains 57 abstracts, 38 of which are new entries to the previous edition.)

55899 (UR—3490-1387) **Annual report, University of Rochester Biomedical and Environmental Research Project: brief description of research papers accepted for publication during 1977.** Nash, D.B. (Rochester Univ., NY (USA). Biomedical and Environmental Research Project). 11 May 1978. Contract EY-76-C-02-3490. 105p. Dep. NTIS, PC A06/MF A01.

Approximately 200 abstracts are presented on various aspects of biomedical and environmental research. (HLW)

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 55587, 55781, 55782, 55786

55900 (ORNL/TM—6410) **Nuclear medicine technology progress report for quarter ending March 31, 1978.** Knapp, F.F. Jr. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

Progress is reported for the applications of ^{11}C, /sup 195m/Pt, and ^{78}Se. Further human clinical trials with ^{11}C-1-aminocyclobutane carboxylic acid and ^{11}C-DL-tryptophan are reported, and batch production of the ^{11}C-DL-tryptophan has increased twofold to 300 mCi. Detailed studies of the effect of the method of administration of /sup 195m/Pt-labeled cis-dichlorodiammine platinum (II) on the tissue distribution and retention of /sup 195m/Pt are reported. Selenium-75-labeled β-aminoethyl selenosulfate has been prepared as a potential myocardial imaging agent. The ORIS-11 version 01 has been tested successfully on a clinical Gamma-11 nuclear medical imaging system at Vanderbilt University.

55901 (AD-A—048843) **The inhalation method of ventilatory scintigraphy of lungs with colloidal indium.** Granowska, M.; Ajewski, Z.; Graban, W. Translated by J. Hanus from *Pol. Przegl. Radiol. Med. Nukl.;* **40**: No. 4, 273-275(1976). 10p. (FTD-ID(RS)T—1110-77). NTIS PC A02/MF A01.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 55850

55902 Dynamics of the content of protein and free intracellular amino acids in the yeasts Cadida utilis under different modes of cultivation. Shkidchenko, A.N. (Inst. of Biochemistry and Physiology of the Microorganisms, Pushchino, USSR). *Izv. Akad. Nauk SSSR, Ser. Biol.;* No. 4, 571-576(1977). (In Russian).

The dynamics of protein and free intracellular amino acids content is described in the course of periodic cultivation of the yeasts Candida utilis. The content of protein and amino acid pool of the cells decreased during the transition from the lag-phase to the phase of acceleration and increased along with the termination of growth and development of the population. It was shown that during continuous cultivation of the yeasts under chemostate conditions when growth is limited by nitrogen and phosphorus sources, protein content and the amount of the amino acid pool depend on the nature of the factor limiting growth. The quantity of the cell protein under conditions of continuous cultivation was maintained at a certain level, though the content of separate bound amino acids became altered.

PATHOLOGY

REFER ALSO TO CITATION(S) 55925, 55927, 55928

55903 (SRO—965-1) **Aeromonas hydrophila as an agent of infection in alligators. Phase I, final report. Progress report, September 1, 1976—September 30, 1977, Part I.** Gorden, R.W.; Esch, G.W. (Wake Forest Univ., Winston-Salem, NC (USA)). Jan 1977. Contract EY-76-S-09-0965. 20p. Dep. NTIS, PC A02/MF A01.

Experimental alligators were exposed to various concentrations of young, washed cells of Aeromonas hydrophila under controlled conditions. Responses of all alligators were monitored on the basis of: observations of external lesions; immunoglobulin production; blood chemistry and hematology; bacteriology, parasitology, and pathology of internal organs, skeletal muscle and external lesions at necropsy. The findings are summarized.

55904 (SRO—965-2) **Aeromonas hydrophila as an agent of infection in alligators. Phase II, final report; Phase III, partial report. Progress report, September 1, 1976—September 30, 1977, Part II.** Gorden, R.W.; Esch, G.W. (Wake Forest Univ., Winston-Salem, NC (USA)). Jun 1977. Contract EY-76-S-09-0965. 10p. Dep. NTIS, PC A02/MF A01.

Studies on experimental alligators exposed to Aeromonas hydrophila showed that alligators are sensitive to heat, handling, and bacterial stress, and they react to this stimulation by predictable defensive mechanisms including increased WBCs, increased antibodies, increases in the α_2: albumin peak on quick scan electrophoresis, and by lesions and possibly death if they are unable to produce adequate defenses. Extensive lesions are more likely to develop on alligators kept in 30 to 35°C water, with death also most likely at these temperatures. Feeding the alligators apparently upset the biological balance in the holding tanks because different bacteria were dominant at different temperatures, few A. hydrophila were found in lesions or internal organs of dead or live alligators, and control alligators in warm water were as likely to become infected and die as were experimental alligators.

55905 Hypergranular promyelocytic leukemia (APL): cytogenetic and ultrastructural specificity. Testa, J.R.; Golomb, H.M.; Rowley, J.D.; Vardiman, J.W.; Sweet, D.L. Jr. (Univ. of Chicago). *Blood;* **52**: No. 2, 272-280(Aug 1978).

Cytogenetic and ultrastructural findings were important diagnostic indicators of hypergranular promyelocytic leukemia (APL) in a patient whose bone marrow morphology appeared, by light microscopy, to be similar to that in acute myeloblastic leukemia (AML) with maturation. Peripheral blood smears and bone marrow specimens examined by light microscopy showed few cells with the numerous coarse, azurophilic granules typical of APL. Cytogenetic analyses, with several banding techniques, of cells from bone marrow and unstimulated peripheral blood revealed the 15; 17 translocation, which has been observed only in APL. A reinterpretation of the reciprocal translocation, based on R banding, suggests that the breakpoints are distal to q24 in No. 15 and at or near the junction of q21 and q22 in No. 17. In addition, the patient had disseminated intravascular coagulation. The characteristic morphology of granules seen in APL was observed in this case only when transmission electron microscopy was used, since the granules were quite small. Since treatment for AML differs from that for APL, identification of the 15; 17 translocation and ultrastructural evidence of granules represents valuable diagnostic aids for APL.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 55907

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 55864, 55905

55906 Theory of equilibrium binding of asymmetric bivalent haptens to cell surface antibody: application to histamine release from basophils. Wofsy, C.; Goldstein, B.; Dembo, M. (Univ. of California, Berkeley). *J. Immunol.;* **121**: No. 2, 593-601(Aug 1978).

We present a theory of the reversible binding of asymmetric bivalent haptens to cell surface antibody in the presence or absence of monovalent hapten. Bivalent haptens can link together bivalent antibodies to form linear chains or rings on cell surfaces. We show how to calculate the amount of any possible complex of bound bivalent hapten, monovalent hapten, and antibody. We first treat the mixed hapten case, when the bivalent hapten is made up of two noncross-reacting haptenic groups, and the basophil has on its surface antibody against both haptenic groups. We further restrict our considerations to the situation where both antibody populations are homogeneous. For this case we show that the fraction of antibody on the cell surface that is involved in complexes of two more antibodies, i.e., the fraction of antibody which is cross-linked, possesses a number of general properties. We use these theoretical results to interpret the experiments of Siraganian et al., who, with the mixed hapton BPO-NH-$(CH_2)_8$-NH-DNP, studied the in vitro histamine release of basophils from allergic rabbits. We conclude that in these experiments the histamine release curves follow the cross-linking curves, i.e., the histamine release curves rise when cross-links are predicted to rise, are a maximum when cross-links are prediced to be a maximum, and fall when cross-links are predicted to fall. We also treat the case, illustrated by DNP_2-lysine, where the two haptenic groups have different affinities for a single homogeneous antibody population on the cell surface. Again we show that the fraction of antibody which is cross-linked possesses a number of general properties.

TRACER TECHNIQUES

55907 Hydroxyproline peptides and bone mass in postmenopausal and osteoporotic women. Aloia, J.F.; Cohn, S.H.; Zanzi, I.; Abesamis, C.; Ellis, K. (Brookhaven National Lab., Upton, NY). *J. Clin. Endocrinol. Metab.;* **47**: No. 2, 314-318(Aug 1978).

Total and nondialyzable hydroxyproline excretion was measured in 59 postmenopausal women and 68 women with spinal osteoporosis. Hydroxyproline excretion was similar in both groups of women and the hypothesis that hydroxyproline excretion is normally distributed could not be rejected for either group. No relationship was found between hydroxyproline excretion (total and percentage of nondialyzable) and body weight, height, body surface area, or total body potassium; there was also no relationship found with total body calcium or bone mineral content of the radius, or these latter values normalized for age, sex, and body size. There was no difference in hydroxyproline excretion in osteoporotic women who took supplemental calcium as compared to those that did not. These data fail to provide any evidence that bone turnover in osteoporotic women differs from that in younger postmenopausal women, or that osteoporosis arises from a subpopulation of women with rapid bone loss.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 55922, 55923

BIOMEDICAL SCIENCES, APPLIED STUDIES

IN VITRO

REFER ALSO TO CITATION(S) 55881

RADIATION EFFECTS ON CELLS

55908 Studies of the erythroid inductive microenvironment in vitro. van Zant, G.; Goldwasser, E.; Pech, N. pp 71-80 of Experimental hematology today. Baum, S.J.; Ledney, G.D. (eds.). New York; Springer-Verlag (1977).

Spleen cells from radiated mice (XS), but not from normal mice (NS), when combined with mouse marrow cells in vitro, had two effects on hemoglobin synthesis: (1) increased baseline, and (2) augmented erythropoietin-induced, hemoglobin formation. Spleen cells from normal and radiated rats caused increased hemoglobin synthesis by rat marrow cells in a dose-dependent manner. In addition, lung and thymus cells from radiated rats, but not from normal rats, caused increased hemoglobin synthesis by rat marrow cells. Rat NS augmented hemoglobin formation by mouse marrow, but neither mouse NS nor mouse XS had an effect on rat marrow. Medium from rat NS cultures stimulated hemoglobin synthesis when added to rat marrow cells. The increases in baseline, and in the response to erythropoietin, were dependent on the amount of "conditioned medium." The substance in the medium responsible for these effects was not erythropoietin.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 54691, 55104, 55849, 55896

55909 (N—78-12657) **Provisional standards of radiation safety during flights.** Oct 1977. Translated from pp 1-8 of Vremennyye Normy Radiatsionnoy Besopasnosti Pri Kosmicheskikh Poletakh. (NASA-TM—75051). 9p. NTIS PC A02/MF A01.

Radiation effects during space flights are discussed in the context of the sources and dangers of such radiation and the radiobiological prerequisites for establishing safe levels of radiation dosage. Standard safe levels of radiation during space flight are established.

55910 Assessment of neutron/gamma-ray dose ratios in intracavitary ^{252}Cf neutron therapy. Tai, D.L.; Maruyama, Y. (Univ. of Kentucky, Lexington). *Radiology;* **128**: No. 3, 795-797(Sep 1978).

From 63. scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL, USA (27 Nov 1977).

Californium-252 was used to treat tumors of the cervix, vagina, and uterus. Dosimetric analysis and assessment of n/γ ratios achievable under clinical conditions indicate that this radionuclide may be useful in gynecologic brachytherapy.

55911 Working safely around implanted radiation sources. Breeding, M.A.; Wollin, M. *Nursing (Jenkintown, Pa.);* **6**: No. 5, 58-63(May 1976).

The article is concerned with patients in whom applicators containing cesium have been vaginally or cervically implanted. In working with such patients, radiation exposure to the attendant can be minimized in several ways: working as far as possible from the radiation source; using a lead shield between patient and attendant; reducing time spent near the patient as much as possible. Film badges and pocket dosimeters indicate levels of radiation to which workers are exposed; more than 400 mrem/month requires investigation by a Radiation Safety Officer. Pregnant attendants should not be assigned to care for patients with sealed radiation sources. Special precautions involving visitors and room assignments are discussed. Various aspects of caring for the patients are detailed. Six informative tables have information about the following: general guide to total time a person may spend with a patient containing a cesium radiation source; equipment for insertion of two types of sources and for removal; general precautions; notes for inserting Fletcher afterloaders, cesium molds and removing cesium.

VERTEBRATES

55912 (CONF-770663—2) **Mutational repair in mammals and its bearing on risk assessment.** Russell, W.L. (Oak Ridge National Lab., TN (USA)). 1977. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From Workshop on repair mechanisms and exposure standards; Oak Ridge, TN, USA (28 Jun 1977).

Most of the genetic risk from radiation in humans will involve germ cell stages that are of long duration, namely, the spermatogonial stem cells in the male and the oocytes in the female. Mutagenic studies in the mouse that are concerned with risk assessment have, therefore, concentrated on these stages. The first evidence that some repair of mutational damage could occur came from investigations with the specific-locus method in the mouse in which it was shown that when a given dose of radiation was spread out evenly over a few weeks, fewer mutations would be obtained than when the same total dose was delivered in a few minutes. In spermatogonia, exploration of the effects of a wide range of radiation dose rates showed that at a dose rate of 0.8 R/min the mutation frequency is only $^1/_3$ to $^1/_4$ of that for the same total doses at 90 R/min. At intermediate dose rates the mutation frequencies are also intermediate. However, when the dose rate is lowered to 0.009, 0.001, or to 0.0007 R/min there is no further reduction in mutation rate below that observed at 0.8 R/min. In oocytes, the mutation frequency depends on the stage of oocyte development. The important stage, so far as human genetic hazards are concerned, is the one of longest duration, namely, the arrested immature oocyte. In extensive radiation experiments in the mouse, this stage has never produced a mutation frequency higher than that in the controls.

55913 (UCRL—52530) **Light-microscopic evaluation of germ-cell loss after prenatal γ-irradiation and electron-microscopic examination of degenerative changes in the dictyate oocytes of the juvenile after γ-irradiation.** Wuebbles, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1978. Contract W-7405-ENG-48. 84p. Dep. NTIS, PC A05/MF A01.

Thesis.

This research consists of two parts. In one part irradiation was used to determine the radiosensitivity of prenatal female germ cells. Mice were given 18 rads of ^{60}Co γ radiation (1 rad/min) at various times in utero. The effect of this treatment was measured by light microscopic enumeration of unilaminar follicles remaining in the ovary at 49 days after birth. Greatest sensitivity was seen for irradiation on day 11 post conception. However the germ cells at this period were not as sensitive as are dictyate oocytes of the juvenile mouse. The other part of this study involved γ irradiation of 14-day-old female mice. Electron microscopy was used to examine the ultrastructural changes taking place in the dictyate oocyte as a response to the radiation. Among the observed changes were irregular nuclear shape, nuclear membrane swelling, chromatin clumping, increased numbers of lysosomes, and enlarged lysosomal areas. The significance and degree of these changes are discussed.

NUCLIDE KINETICS AND TOXICOLOGY

REFER ALSO TO CITATION(S) 55871

MAN

REFER ALSO TO CITATION(S) 54715, 55900

ANIMALS

55914 (ORAU/IEA—78-9(M)) **Dose-response curves from incomplete data.** Groer, P.G. (Oak Ridge Associated Universities, Inc.,

TN (USA). Inst. for Energy Analysis). Mar 1978. Contract EY-76-C-05-0033. 14p. (CONF-780306—9). Dep. NTIS, PC A02/MF A01.

From Symposium on late biological effects of ionizing radiation; Vienna, Austria (13 Mar 1978).

A procedure is described which uses the now classical Kaplan-Meier estimator to establish dose-response curves from incomplete data under the assumption that the different observed responses are statistically independent. It is pointed out that for incomplete data the shape of the dose-response curve is undecidable in some situations. An example given using actual data to illustrate the estimation procedure is the dose-response curve for beagles that received injecions of ^{226}Ra and ^{228}Th.

55915 Intracellular translocation of iodine-125-labeled insulin: direct demonstration in isolated hepatocytes. Gorden, P. (Univ. of Geneva); Carpentier, J.L.; Freychet, P.; LeCam, A.; Orci, L. *Science;* **200**: No. 4343, 782-784(19 May 1978).

Insulin labeled with iodine-125 binds to receptors on isolated rat hepatocytes. At low temperatures initial binding is restricted to the plasma membrane as detected by direct quantitative autoradiographic analysis with the electron microscope. With increasing time and temperature of incubation there is a systematic and progressive translocation of autoradiographic grains to a highly limited area of the cell periphery representing no more than 15 percent of the radius of the cell.

PLANTS

REFER ALSO TO CITATION(S) 55832

THERMAL EFFECTS

55916 (NTIS/PS—78/0172) **Thermal pollution. Part 2. Biological effects. Volume 2. 1974-February, 1978 (a bibliography with abstracts). Report for 1974-Feb 78.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 214p. NTIS PC N01/MF N01.

Abstracts covering the effects of heated effluents on fish, shellfish, microorganisms, and plants in both fresh and salt water are presented, including the effects on growth, ecology, metabolism, heat tolerance, and productivity. The effluent sources are both power and industrial plants.

MICROORGANISMS

55917 (TID—28525) **Effect of thermal effluent on nitrogen fixation in the sediments of Guayanilla Bay, Puerto Rico.** Kimball, M.C. (Miami Univ., Coral Gables, FL (USA)). Jun 1977. Contract EY-76-C-05-0033. 112p. Dep. NTIS, PC A06/MF A01.

Thesis.

Nitrogen fixation by sediment microflora was studied from March, 1976 through January, 1977 in Guayanilla Bay on the south coast of Puerto Rico. The study site was located in an area which receives thermal effluent from a power plant. The temperatures annually ranged from approximately 25° to 30°C in the control areas, and from approximately 30° to 40°C in the discharge area. Rates of nitrogen fixation were measured in situ with the acetylene reduction technique. High rates of nitrogen fixation generally corresponded with the development of blue-green algal mats. A blue-green algal mat, predominantly composed of Microcoleus vaginatus, formed in the discharge area when temperatures were at or above 35°C. Chlorophyll-a content in this mat reached maximum values of 600 mg/meter^2 in shallow areas (i.e., depths of 0.5 meter or less). The highest rates of nitrogen fixation were found in portions of the mat growing in the intertidal zone in August. These rates ranged as high as 2.17 and 0.76 mg/meter^2/hour for light and dark incubated samples, respectively. Rates of nitrogen fixation decreased with depth, and hence also light intensity. Despite high rates of fixation by light incubated samples (hence, predominantly photosynthetic organisms), dark heterotrophic processes (bacteria) appeared to account for the majority of nitrogen fixed in the blue-green algal mat during a twenty-four hour period.

VERTEBRATES

55918 (SRO—900-3) **Impact of thermal loading and other water quality parameters on the epizootiology of red-sore disease in centrarchids. Progress report, December 1, 1977—November 30, 1978.** Esch, G.W.; Hazen, T.C. (Wake Forest Univ., Winston-Salem, NC (USA). Dept. of Biology). Jul 1978. Contract EY-76-S-09-0900. 58p. Dep. NTIS, PC A04/MF A01.

The implications from these studies are varied, sometimes clear and sometimes less so, for many of the results have raised new and even more critical questions. Thus, our data clearly show that Aeromonas hydrophila is the etiological agent for red-sore disease. Furthermore, they suggest that the effects of temperature are two-fold, first in increasing the density of the pathogen in the water column and then in affecting the physiology of the host organism to such an extent as to increase the probability of acquiring the pathogen. On the other hand, organic loading, suggested by other investigators as being important in red-sore disease, was not identified as being significant in the present study. However, if organic loading, or any of its consequences, can be shown to induce stress, then it may be as important in other systems as temperature is in Par Pond. Thus it is quite conceivable that it (organic loading), or some other water quality parameter, may create conditions conducive to increasing densities of A. hydrophila while simultaneously producing water quality characteristics which would lead to stress in fish, and then to increasing the probability of fish acquiring red-sore disease. An enigmatic observation (see Hazen, 1978, for details) is that A. hydrophila has been recovered from a variety of habitats throughout the U.S., yet red-sore disease is known to occur only in the southeast. This peculiar distribution pattern raises several important questions regarding the epizootiology of red-sore, not the least of which is the possibility of there existing differentially virulent strains of A. hydrophila and/or more or less susceptible populations of potential hosts in various parts of the country. Other significant questions are related to the variability in amplitude of red-sore disease from one year to the next among bass in Par Pond, the mode of entry of the pathogen into largemouth bass, and the basic, cellular mechanisms of stress in largemouth bass.

CHEMICALS METABOLISM AND TOXICITY

CELLS

REFER ALSO TO CITATION(S) 54638

MICROORGANISMS

REFER ALSO TO CITATION(S) 54638

55919 (CONF-780668—1) **Mutagenicity testing of energy-related compounds.** Epler, J.L. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 11p. Dep. NTIS, PC A02/MF A01.

From Conference on energy and health; Alto, UT, USA (26 Jun 1978).

To rapidly determine the potential biohazards (mutagenicity) of various crude and complex test materials derived from fossil fuel conversion activities, the feasibility of using short-term genetic assays to predict, isolate, and identify the chemical hazards. The biological screening assay using the Salmonella-mammalian microsome method was coupled to an analytical chemistry separation procedure so that the chemical work and priorities for identification could be determined by the bioassay. It was concluded that the detection of mutagenic activity may well be a function of the chemical fractionation scheme utilized. The inability to recover specific chemical classes or the formation of artifacts by the treatment could well distort the results obtained, as could an inability to detect the specific biological end point chosen.

55920 (NTIS/PS—78/0193) **The biological effects of oil spills (a bibliography with abstracts). Report for 1964-Feb 78.** Harrison, E.A. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 247p. NTIS PC N01/MF N01.

The selected abstracts cover aspects of the biological and ecological effects of oil spills in salt and fresh water. The effects on microorganisms, plants, and animals are studied, along with research on the residues and metabolic products of various oil components. (This updated bibliography contains 242 abstracts, 51 of which are new entries to the previous edition.)

PLANTS

REFER ALSO TO CITATION(S) 55827, 55831, 55832, 55920

55921 (ORO—4254-6) **Vertical variation in nitrate uptake by natural population of reservoir plankton. Final report.** Varga, L.P. (Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry). [nd]. Contract EY-76-S-05-4254. 16p. Dep. NTIS, PC A02/MF A01.

The purpose of this study was to describe the vertical profile of nitrate (NO_3^-) uptake by phytoplankton in the euphotic zone of Lake Carl Blackwell, Oklahoma. Light intensity, nutrient concentrations, and biomass were determined at all sample depths to identify the environmental factors controlling uptake. Three experiments were conducted in which samples were collected at depths corresponding to 90, 50, 25, 10, and 1 percent of incident surface radiation. Clear 1 liter bottles containing water from each depth were enriched with ^{15}N labeled KNO_3 to achieve concentrations approximately 10 percent and 1000 percent above the ambient NO_3^- con-

centration. Four additional bottles containing water from the 50 percent depth were enriched with ^{15}N-KNO_3 to concentrations approximately 20, 30, 100, and 300 percent above the ambient NO_3^- concentration to determine Michaelis-Menten constants. An unlabeled control bottle and an enriched dark bottle were prepared for each depth, and all samples were incubated in situ for 24 h at the depth from which they were drawn. After incubation the particulate matter in each bottle was retained on a glass fiber filter and NO_3^- uptake velocities were calculated from the ^{15}N:^{14}N ratio in the particulate fraction.

55922 Excess trace metal effects on cotton. III. Chromium and lithium in solution culture. Rehab, F.I.; Wallace, A. (Univ. of California, Los Angles). *Commun. Soil Sci. Plant Anal.;* 9: No. 7, 637-644(1978).

Two cultivars of cotton (Gossypium spp) were grown in solution culture in a glasshouse to determine phytotoxicity effects of excesses of Cr and Li. The 10^{-4}M $Cr_2(SO_4)_3$ resulted in leaf yield reduction of 83 percent and in leaf, stem, and root concentrations respectively of 22, 15, and 410 μg Cr/g with the Acala SJ-2 cv. With the Giza 68 cv. the same level of Cr resulted in leaf yield reduction of 88 percent and in 19, 47, and 450 μg Cr/g for leaf, stem, and roots respectively. The Cr resulted in many mineral interactions. The 10^{-4}M Li_2SO_4 resulted in very little if any yield reductions in either cv. Plant Li concentrations were 40, 8, and 10 and 45, 10, and 5 for leaf, stem, and root for Acala SJ-2 and Giza 68 respectively. Both cultivars tolerated Li equally well.

55923 Excess trace metal effects on cotton. IV. Chromium and lithium in Yolo loam soil. Rehab, F.I.; Wallace, A. (Univ. of California, Los Angles). *Commun. Soil Sci. Plant Anal.;* 9: No. 7, 645-651(1978).

Two cultivars of cotton (Gossypium spp) were grown in Yolo loam soil in a glasshouse to determine phytotoxicity effects of Cr and Li and possible interactions with other metals. The Cr at 100 μg/g soil had no adverse effects on either cultivar studied. A Cr increase was not observed in either stems or leaves. Both cultivars tolerated 25 and 50 μg Li/g soil. The 50 μg Li/g soil resulted in leaves of Acala SJ-2 with 432 μg Li/g leaves and 720 in Giza 45. The 100 μg Li/g soil resulted in 74 percent and 87 percent leaf yield reductions in Acala SJ-2 and Giza 45 respectively. Leaf concentrations of Li respectively were 1950 and 1850 μg/g. Except at the highest level of Li, leaves had higher concentrations of Li than did roots. The Cr and Li resulted in some plant metal interactions.

INVERTEBRATES

REFER ALSO TO CITATION(S) 54638, 55920

VERTEBRATES

REFER ALSO TO CITATION(S) 54638, 55920

55924 Dyskinesias evoked in monkeys by weekly administration of haloperidol. Weiss, B.; Santelli, S. (Univ. of Rochester, NY). *Science;* 200: No. 4343, 799-801(19 May 1978).

In two cebus (Cebus albifrons) monkeys given weekly oral doses of 0.25 milligram of haloperidol per kilogram, movement disorders appeared 1 to 8 hours after drug administration following the tenth weekly dose. These disorders included oral movements, peculiar postures, writhing, and stretching. Such reactions faded in intensity after the next two doses. Increasing the dose to 0.5 milligram per kilogram has elicited the disorders reliably after each weekly dose for almost 2 years. Similar reactions also developed in a squirrel monkey (Saimiri sciurea) treated weekly with haloperidol and in a third cebus monkey previously maintained for a year on a regimen of 0.25 milligram of haloperidol per kilogram on 5 days per week. These findings suggest an experimental model for determining the etiology of drug-induced movement disorders. They also suggest an unrecognized clinical problem.

55925 (SRO—900-2) Impact of thermal loading and other water quality parameters on the epizootiology of Epistylis and Aeromonas infections of centrarchids. Progress report, September 1, 1976—July 30, 1977. Esch, G.W.; Dimock, R.V. (Wake Forest Univ., Winston-Salem, NC (USA). Dept. of Biology). Aug 1977. Contract EY-76-S-09-0900. 44p. Dep. NTIS, PC A03/MF A01.

During the past year, mounting evidence has been accumulated which indicates that the causative agent for red-sore disease among bass is the bacterium, Aeromonas hydrophila, and not the ciliate, Epistylis, as suggested in previous literature. Red-sore disease among bass in Par Pond continues to be highly seasonal with peak periods of infection occurring in spring and summer, with declining levels in fall and summer. The disease continues to be more prevalent among bass from thermally altered areas of the reservoir during all seasons except summer. Definite correlations were established between temperature, dissolved oxygen, pH, and Aeromonas density in the water column. Furthermore, the level of Aeromonas cell counts in the water column and incidence of the disease in bass was clearly established. Body condition of bass and probability of acquiring red-sore disease were also related. Histopathology of tissues from bass suggested lesions were produced by acute, lytic toxicity such as would be produced by bacterial exotoxins. Based on these observations, a tenative hypothesis is proposed which attempts to link various physico-chemical parameters, body condition of bass, probability of infection by Aeromonas, and stress.

55926 (UR—3490-1231) Fluoride as a ecopoison. Smith, F.A. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1977. Contract EY-76-C-02-3490. 44p. (CONF-770764—1). Dep. NTIS, PC A03/MF A01.

From NATO workshop on ecopoisons; Guildford, UK (11 Jul 1977).

Direct hazards to man associated with airborne fluorides are indeed significant, and investigations into the effects of airborne fluorides have ample justification for both practical and theoretical reasons. This paper describes the results obtained to date of studies of the effect of airborne particulate fluoride (fluorspar, calcium fluoride, CaF_2) and of HF in guinea pigs. Animals were exposed 6 hrs/day, 5 days/week for 4 weeks to dust containing 0.8 mg F/m³ as respirable size CaF_2; the concentration was then increased to 1.2 mg F/m³ for weeks 5—16. Growth and body weight, organ weight-to-body weight ratio for lung + trachea, kidney and liver, fluoride in bile, urine and kidney, microscopic appearance of kidney and liver, and femoral mass, density and structural detail evident in x-ray films, all were not significantly affected by the exposure. Concentrations of fluoride in the plasma, feces, femoral bone ash, and lung + trachea all were increased as a result of the inhalation of the fluoride-containing dust. Upon termination of the daily exposures, fluoride concentrations in the plasma and feces were again normal after 25 days.

55927 Effects of 7,8-benzoflavone of skin tumor-initiating activities of various 7- and 12-substituted derivatives of 7,12-dimenthylbenz[a]anthracene in mice. DiGiovanni, J. (Univ. of Washington, Seattle); Slaga, T.J.; Viaje, A.; Berry, D.L.; Harvey, R.G.; Juchau, M.R. *J. Natl. Cancer Inst.;* 61: No. 1, 135-140(Jul 1978).

The skin tumor-initiating activities of various 7- and 12-substituted derivatives of 7,12-dimethylbenz[a]anthracene (DMBA) were investigated in female outbred Charles River CD-1 mice. 7-Formyl-12-methylbenz[a]anthracene (7-CHO-12-MBA) at 740 nmoles/mouse was an effective tumor initiator, at a dose 74-fold greater than that of DMBA. 7,8-Benzoflavone (7,8-BF) inhibited the tumor-initiating activity of 7-CHO-12-MBA by 51%. 12-Formyl-7-methylbenz[a]anthranene and 7,12-diformylbenz[a]anthracene, applied at initiating doses of 740 nmoles and 704 nmoles/mouse, respectively, were much less active than 7-CHO-12-MBA. 7-Bromomethyl-12-methylbenz[a]anthracene (7-BRME-12-MBA) and 7-bromomethylbenz[a]anthracene (7-BRMEBA) were also investigated. 7-BRME-12-MBA was a more effective tumor initiator than 7-BRMEBA, but both were less active than DMBA. 7,8-BF inhibited the tumor-initiating activity of 7-BRME- 12-MBA and 7-BRMEBA by 34 and 54%, respectively. 12-Bromomethyl-7-methylbenz[a]anthracene (12-BRME-7-MBA) was as active an initiator as 7-BRME-12-MBA. 7,8-BF inhibited tumor initiation with 12-BRME-7-MBA by 29%. Three naturally occurring flavones, quercetin, myricetin, and 4',5,7-trihydroxyflavonone, and the cytochrome P_{450}, inhibitor 1-benzylimidazole were investigated after topical application(100 μg) for their effects on tumor initiation with DMBA. Quercetin inhibited tumor initiation with DMBA. Quercetin inhibited tumor initiation with DMBA by 22%, whereas myricetin and 4',5,7-trihydroxyflavanone enhanced tumor initiation with DMBA by 54 and 29%, respectively. 1-Benzylimidazole had no effect. The abilities of the flavones and 1-benzylimidazole to inhibit aryl hydrocarbon hydroxylase in vitro did not correlate with their effects on tumor initiation with DMBA.

55928 Selective sex-related modification of diethylnitrosamine-induced carcinogenesis in BALB/c mice by concomitant administration of butylated hydroxytoluene. Clapp, N.K.; Tyndall, R.L.; Satterfield, L.C.; Klima, W.C.; Bowles, N.D. (Oak Ridge National Lab., TN). *J. Natl. Cancer Inst.;* 61: No. 1, 177-182(Jul 1978).

Tumor induction in BALB/c mice by diethylnitrosamine (DENA) was shown to be sex related. Female mice killed 13.5 months after DENA exposure generally had higher incidences of forestomach and lung tumors than did males and also had higher numbers of lung tumors per tumor-bearing mouse. Although neither sex developed stomach tumors spontaneously, males had higher incidences of spontaneous lung tumors than did females (45 vs. 26%). When butylated hydroxytoluene (BHT) was given concomitantly with DENA treatment, females had an increased survival (68 vs. 43%) and a reduced incidence of forestomach squamous cell carcinomas (77 vs. 100%) compared with females given DENA alone. No such protective effect on survival or on the occurrence of stomach tumors was seen in males given BHT and DENA or on

lung tumorigenesis in either sex. In males, BHT given alone increased survival of treated mice over that of untreated controls, but it had no such effect on the females. The results of this study suggested an as yet unexplained hormonal influence and/or dependence for this BHT modification of DENA tumorigenesis.

55929 Proof of fluorescent aerosols in homogenates of the rat respiratory tract. Muacevic, G. *Staub-Reinhalt. Luft;* **38**: No. 2, 67-68(Feb 1978). (In German).

Fluorescent aerosols are used to detect aerosol depositions in the respiratory tract of experimental animals. With the method used, the substances can be quantified in lung homogenates. Of the fluorescent materials used, ethidium bromide is most suitable as a fluorescent reagent, due to the fact that it forms stable, strongly fluorescent compounds with nucleic acids. Fluorimetric detection of the tracer also allows a quantitative statement concerning the total amount inhaled.

MAN

REFER ALSO TO CITATION(S) 54522, 55834, 55926

55930 (PB—277019) Health hazard evaluation/toxicity determination report 74-16-272, Marathon Battery Company, Waco, Texas. Thoburn, T.W.; Larsen, L.R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1976. 47p. (NIOSH-TR—74-16-272). NTIS PC A03/MF A01.

A health hazard evaluation investigation was conducted by NIOSH at the Marathon Battery Company in Waco, Texas, acting on a request from an authorized employee representative regarding exposure to dust and fumes in maintenance and production areas in the nickel-cadmium battery assembly factory. The prevailing symptoms among the approximately 60 affected predominantly female employees, was nausea. Environmental evaluation revealed that a potential hazard exists to employees from exposure to nickel and cadmium dusts. Workers in 4 departments showed levels of cadmium and nickel in hair and urine above those found in the control group; workers in 2 of the 4 departments also showed excessive symptomatology and physical findings indicating upper respiratory irritation. Air samples also showed some excessive levels of cadmium and nickel particularly in these same 2 departments. However, medical evaluation of employees failed to demonstrate any apparent serious occupationally induced illness.

55931 (RR—75-1A) Report on emissions from asphalt hot mixes. Puzinauskas, V.P.; Corbett, L.W. (Asphalt Inst., College Park, MD (USA); Exxon Research and Engineering Co., Linden, NJ (USA)). May 1975. 21p. Asphalt Inst., College Park, MD.

A comprehensive analysis of eight sets of samples of emissions originating from petroleum asphalt during the hot-mix process for preparation of asphalt paving mixes was carried out. Samples were collected on four days at two locations involving four asphalt cements of varying characteristics from three refineries. All gaseous substances, vapors and particulates which possibly could be associated with asphalt, including hydrocarbons, carbon monoxide, nitrogen dioxide, volatile sulfur compounds, ozone, aldehydes, phenols, metals and polynuclear aromatics, were identified using well recognized and accepted sampling techniques and analytical procedures. Based on test data of these analyses it was concluded that no significant air pollution or employee health problems can be expected or associated with the emissions from hot preparation of asphalt paving mixtures.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

55932 (AD-A—049946) Corneal damage thresholds for infrared laser exposure: empirical data, model predictions, and safety standards. Final report Apr 75—Jun 77. Egbert, D.E.; Maher, E.F. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Dec 1977. 64p. (SAM-TR—77-29). NTIS PC A04/MF A01.

Experimental damage threshold data for corneal injury from infrared lasers are compared with thermal model predictions of temperature rise, lesion radius, and damage threshold using several damage criteria. The functional dependence of the threshold exposure upon damage end-point, damage criteria, absorption coefficient, beam radius, exposure duration, and damage site is determined. Experimental and predicted thresholds are compared to the ANSI Z136.1-1976 laser safety standard. Similar analysis with the thermal model for applications such as photokeratoplasty or corneal and lenticular spectroscopy can yield alternative approaches to either maximize or avoid thermal effects often inherent in such research.

55933 (IS-EMRRI—6) Bibliography of topics related to the study of grain-dust fire and explosion with keyword indexes. Verkade, M.; Chiotti, P. (Iowa State Univ. of Science and Technology, Ames (USA). Energy and Mineral Resources Research Inst.). May 1978. Contract W-7405-ENG-82. 176p. Dep. NTIS, PC A09/MF A01.

This bibliography, which contains 871 citations, is intended for use by those studying the problem of dust explosions in grain elevators, feed mills, and related industries. The survey focuses primarily on the period from 1955 through 1975, although older sources, when considered relevant, and a number of 1976 references are included. Within these limits a complete listing of pertinent sources has been attempted. A key word index is included.

55934 (IS-EMRRI—7) Supplement to a bibliography of topics related to the study of grain-dust fire and explosion with keyword indexes, November 1976—May 1978. Verkade, M.; Bluhm, D. (Iowa State Univ. of Science and Technology, Ames (USA). Energy and Mineral Resources Research Inst.). Jul 1978. Contract W-7405-ENG-82. 111p. Dep. NTIS, PC A06/MF A01.

This bibliography provides a compilation of recent work published in the many areas which may be of interest to those involved in studying, designing, and implementing programs to reduce the hazards of grain dust explosions. The literature search focused primarily on the period from January 1976 to May 1978. A key word index is included. Previous publications surveyed the literature for the period from 1900 through 1975 with special emphasis on the years 1955 through 1975.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 54521, 55263, 55740, 55840

GEOSCIENCES

GEOLOGY AND HYDROLOGY

55935 (RHO-BWI-C—4) Gravity studies of the Hanford Reservation, Richland, Washington. Richard, B.H.; Lulie, J.T.; Deju, R.A. (Atomics International Div., Richland, WA (USA). Rockwell Hanford Operations). Jul 1977. Contract EY-77-C-06-1030. 14p. Dep. NTIS, PC A02/MF A01.

Gravity studies over Hanford added to the understanding of the geology of the Pasco Basin. The Bouguer anomaly indicated the basin is the site of the greatest thickness of Columbia River Basalt. The residual gravity anomaly delineated the major anticlinal and synclinal structures under Hanford. Three-dimensional gravity models characterized these buried folds by indicating their shape and relief. Finally, two-dimensional gravity models further delineated the shape of these buried folds and suggested locations where ancestral rivers may have breached the Umtanum anticlinal folds within the basin. Analysis of the three-dimensional model studies indicates that one-fifth of the original data would have delineated the buried structures. Two- or three-body gravity models produced better results than a poly-body model. Gravity was found to be an effective and rapid reconnaissance method of studying buried bedrock structures.

55936 (RHO-BWI-C—6) Analysis of selected gravity profiles on the Hanford Reservation, Richland, Washington. Little, J.T.; Richard, B.H. (Wright State Univ., Dayton, OH (USA). Dept. of Geology). Jul 1977. Contract EY-77-C-06-1030. 96p. Dep. NTIS, PC A05/MF A01.

Regional gravity surveys have been conducted on the Hanford Reservation in the past. This analysis is an attempt at detailed gravity profiling over selected areas of the reservation. Over 450 gravity readings were taken during the summer of 1976. The Bouguer anomaly values of these stations, along with facies cross sections, were used to construct two-dimensional models. The models depict the buried basalt bedrock surface and the overlying sedimentary cover of the areas selected for profiling. In the eastern section of the reservation, the interpretation of the data suggests that there are three major buried valleys cut into the bedrock. These channels are most likely a combination of structural downwarping and erosion of these downwarps by an ancestral Columbia River. Along the western boundary of the reservation there are two closed depressions which are believed to be the result of the sub-fluvial vortex effect of Kolk erosion. It was found that, although two-dimensional gravity models are useful in determining the buried bedrock surface, they are ineffectual in delineating sedimentary contacts.

55937 Rb—Sr geochronologic investigation of Precambrian silicic rocks from the Zuni Mountains, New Mexico. Brookins, D.G.; Della Valle, R.S.; Lee, M.J. (Univ. of New Mexico, Albuquerque). *Mt. Geol.;* **15**: No. 2, 67-71(Apr 1978).

The Rb—Sr whole rock isochron age for metarhyolite from the Zuni Mountains, New Mexico, is 1.38 +- 0.03 b.y. with initial $^{87}Sr/^{86}Sr$ = 0.721 +- 0.009. The metarhyolite is intruded by a cogenetic suite of gneissic granites, biotite granites, and aplites which yield a Rb—Sr whole rock isochron age of 1.49 +- 0.09 b.y. with initial $^{87}Sr/^{86}Sr$ = 0.7062 +- 0.0008. Although the errors overlap, the metarhyolite has apparently been incipiently altered resulting in its apparent lower age. As the silicic plutonic rocks are all fresh (based on petrographic examination) and clearly intrusive into the metarhyolite, then 1.49 +- 0.09 b.y. is assigned as the minimum age for the Precambrian silicic rocks from the Zuni Mountains.

55938 Geology of the Severn Barrage area. Green, G.W.; Fletcher, B.N. London; Institute of Geological Sciences (1976). 12p. (NP—23280). The Institute, 5 Princes Gate, London SW7 1QN.

An account is given of the onshore and offshore geology of the Severn Barrage area, largely compiled from unpublished Institute of Geological Sciences work in the estuary and on land. The most important preliminary result is that much of the area of the barrage has bedrock exposed at the seabed and is not covered by drift, contrary to evidence available in the report of the Select Committee. Proposals are made for a more detailed survey.

GEOPHYSICS

55939 Applications of thermodynamics to fundamental earth physics. Stacey, F.D. (Univ. of Queensland, Brisbane). *Geophys. Surv.;* 3: No. 2, 175-204(Oct 1977).

New fundamental thermodynamic relationships of complete generality and absolute rigour of derivation are not to be expected, because the subject has such a secure and complete basis in classical physics. There is, however, still scope for original, fundamental work based on recognized assumptions and approximations which may be obviously acceptable in particular situations. Clarification of relationships between thermodynamic parameters for materials within the Earth is particularly important because there is so little possibility of measuring them individually. This survey first summarizes the established relationships in a very condensed form and then concentrates on some recent developments which have direct bearing on the thermal and mechanical states of the Earth's mantle and core. Considerable use is made of the thermodynamic Gruneisen parameter, which is a dimensionless quantity of order unity for almost all materials, solid, liquid and gaseous, and is directly related to the pressure dependences of elastic constants. This allows its value to be estimated for the different regions of the Earth from seismological data. The thermodynamic (heat engine) efficiency of convection in a homogeneous medium, driving tectonic activity or the geomagnetic dynamo, is found to the ideal (Carnot) efficiency corresponding to adiabatic temperature differences between the heat source and sink, within the assumption that the thermal expansion coefficient is not strongly temperature dependent. The use of this conclusion to infer tectonic stresses is indicated. The thermodynamic basis for Lindemann's melting law is restated and the reasons for supposing it to be valid for materials at megabar pressures reaffirmed. Application to the inner core boundary gives a "fixed point" on the Earth's temperature profile. Use of thermodynamic relationships in the interpretation of shock wave compressions is indicated.

SEISMOLOGY AND TECTONICS

REFER ALSO TO CITATION(S) 55181, 55956

55940 (CONF-780618—1) **Propagation of plane waves in granular media.** Nunziato, J.W. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 10p. Dep. NTIS, PC A02/MF A01.

From Symposium on continuum mechanical and statistical approaches in the mechanics of granular materials; Sendai, Japan (5 Jun 1978).

Some recent theoretical results obtained on the propagation of plane longitudinal waves in granular materials are discussed. Using a one-dimensional formulation of the continuum theory of granular materials proposed by Goodman and Cowin, the longitudinal response of two classes of materials was modeled. The two classes are materials with compressible granules, such as pressed powders and sands at high confining pressures, and flowing materials with incompressible granules, such as sands at low confining pressures. The speed and the amplitude of the various types of acceleration waves possible in each class were considered. In materials with compressible granules, two waves were found to exist, an elastic wave followed by a compaction wave. However, in flowing materials with incompressible granules, the only wave possible is a wave of dilatancy. In each case, the influence of the initial material nonuniformity on the wave behavior is discussed, and some experimental observations which correlate with the results of the analysis are cited.

55941 Attenuation of modified Mercalli intensity with distance in the United States. Anderson, J.G. (Univ. of Southern California, University Park). *Bull. Seismol. Soc. Am.;* 68: No. 4, 1147-1179(Aug 1978).

A large number of Modified Mercalli Intensity isoseismal maps for earthquakes which have occurred in the United States have been analyzed to find the distribution of distances (R) between the epicenter and isoseismal contours. The data include most of the maps in the series "United States Earthquakes," and a smaller number of maps from other sources. Where the data permit, best fitting parameters have been found in a Gaussian distribution function to fit the observed distributions of $\log_{10}R$ for each combination of epicentral intensity and the intensity bounded by the contour; the data do not contradict this assumed Gaussian shape. The standard deviation of $\log_{10}R$ is at best 0.2 for well-determined distributions; It is typically 0.3, implying that over an order of magnitude range of distances is present in the data.

55942 Tectonic deformation index for strata definition. Adler, R.E.; Fietz, J.L.; Hemmerich, M.K. *Glueckauf;* 114: No. 4, 169-175(Feb 1978). (In German).

The composition of present day strata is the result of complicated mechanical processes during the course of the earth's history. Therefore tectonic structural analysis, which should give information on the deformation of strata must take many individual factors into account. This is absolutely necessary, as none of these factors on its own characterizes the strata conditions sufficiently. An analysis and comprehensive assessment of these individual factors requires considerable knowledge of geology and strata mechanics. Therefore a special index number was developed for practical use. This includes the assessment of the required detailed results from tectonic structural analysis, and therefore represents a representative value for the degree of deformation of the strata. As this degree of deformation changes appreciable both with intensity of folding and with the appearance of zones of fracture and faults in the strata, indices of tectonic deformation and lines of values are an aid to recognizing the appearance of faults and of other changes in the composition of strata in good time from changes of indices or the arrangement and shape of lines of values.

55943 Coupled hydrodynamic response of concrete gravity dams using finite and infinite elements. Saini, S.S. (Univ. of Roorkee, India); Bettess, P.; Zienkiewicz, O.C. *Int. J. Earthquake Eng. Struct. Dyn.;* 6: No. 4, 363-374(1978).

This paper presents the application of the finite element method for analyzing the two-dimensional response of reservoir-dam systems subjected to horizontal ground motion. The interaction between the dam and the reservoir as well as the compressibility of water has been taken into account. The complete system has been considered to be composed of two substructures, namely the reservoir and the dam. To take into account the large extent of the reservoir, it has been idealized using specially developed infinite elements coupled with standard finite elements while the dam is represented using finite elements alone. Structural damping of the dam and radiation damping in the fluid phase have been accounted for in the analysis. It is concluded that the effect of radiation damping is considerable at high frequencies of excitation. The coupled response of the system is significantly large at and near the fundamental natural frequency of the system in comparison to the uncoupled responses. The method is computationally quite economical, capable of taking into account the arbitrary geometry of the system and is recommended for practical application. Further applications and extensions of the approach to three dimensional analyses are possible.

55944 (UCRL-Trans—11300) **Seismic effects and ejecta craters resulting from underground explosions.** Romashov, A.N.; Kharin, D.A. (eds.). Oct 1977. Translated from pp 109-210, 231-261 of Vzryvnoe delo, sbornik No. 64/21, Nauchno-Tekhn. Gorn. Obshchestvo, Izd, Nedra, Moscow, 1968. 200p. Dep. NTIS, MF A01.

Portions of document are illegible.

Soviet literature on the seismic effect of underground chemical explosions is reviewed. The theoretical aspects of underground explosions, including completely contained explosions, cratering explosions, and the nature of seismic waves generated by underground explosions and the relationship between the characteristics of these waves, explosion parameters, and distance from the explosion are discussed in relation to underground mining. 26 references.

55945 Tectonoelectricity. Yamazaki, Y. (Tokyo Univ.). *Geophys. Surv.;* 3: No. 2, 123-142(Oct 1977).

Anomalous earth-current changes in association with an earthquake occurrence have often been reported since the 19th century. Changes reported in classical as well as recent literature are reviewed, although it is hard to say that any physically clear

relationship between earth-current changes and earthquakes has been established. Even though a strong correlation between precursory earth-current changes and earthquakes has often been reported in the U.S.S.R. and the People's Republic of China in recent years, it appears that a general rule governing the earthquake-related earth-current changes is still very much unknown, partly because of contamination by artificial and natural noise. In contrast to the difficulty in understanding earth-current changes, monitoring of earth-resistivity seems to provide a much clearer means for interpreting geoelectric phenomena in association with tectonic processes in the Earth. Soviet and American work showed that the resistivity decreases to a considerable extent in the focal region prior to an earthquake. Such a change seems to be closely correlated to dilatancy generation in the Earth's crust. This finding doubtless provides an important means for earthquake prediction. An unusual, highly sensitive resistivity variometer, developed by the writer, disclosed that a resistivity change takes place at a teleseismic distance when an earthquake of large and medium magnitude occurs. Many of the resistivity changes thus observed are preceded by a premonitory change, which is supposed to reflect the preliminary rupture at a focal region.

55946 Electromechanical phenomena associated with earthquakes. Dmowska, R. (Inst. of Geophysics, Warsaw). *Geophys. Surv.;* **3**: No. 2, 157-174(Oct 1977).

This article reviews the field, laboratory, and theoretical investigations made concerning different electromechanical phenomena associated with earthquakes. It discusses laboratory measurements of electrical resistivity of rocks stressed up to fracture, particular attention being paid to the interpretation of results according to the diffusion-dilatancy theory. This is followed by the discussion of field measurements of electrical characteristics of rocks in seismic areas in connection with seismic activity in these regions. Piezoelectric and electrostrictive phenomena are briefly discussed, and also a theoretical model of electro-elastic effects associated with an earthquake source. The last part concerns electrokinetic phenomena in porous rocks, caused by the diffusion of fluids into the dilatant focal region. The divergence of opinion about the physical models of the earthquake process is emphasized.

55947 Surveying earth resources by remote sensing from satellites. Otterman, J.; Lowman, P.D.; Salomonson, V.V. (Goddard Space Flight Center, Greenbelt, MD). *Geophys. Surv.;* **2**: No. 4, 431-467(Apr 1976).

The techniques and recent results of orbital remote sensing, with emphasis on Landsat and Skylab imagery are reviewed. Landsat (formerly ERTS) uses electronic sensors (scanners and television) for repetitive observations with moderate ground resolution. The Skylab flights used a wider range of electro-optical sensors and returned film cameras with moderate and high ground resolution. Data from these programs have been used successfully in many fields. For mineral resources, satellite observations have proven valuable in geologic mapping and in exploration for metal, oil, and gas deposits, generally as a guide for other (conventional) techniques. Water resource monitoring with satellite data has included hydrologic mapping, soil moisture studies, and snow surveys. Marine resources have been studied, with applications in the fishing industry and in ocean transportation. Agricultural applications, benefiting from the repetitive coverage possible with satellites, have been especially promising. Crop inventories are being conducted, as well as inventories of timber and rangeland. Overgrazing has been monitored in several areas. Finally, environmental quality has also proven susceptible to orbital remote sensing; several types of water pollution have been successfully monitored. The effects of mining and other activities on the land can also be studied. The future of orbital remote sensing in global monitoring of the Earth's resources seems assured. However, efforts to extend spectral range, increase resolution, and solve cloud-cover problems must be continued. Broad applications of computer analysis techniques are vital to handle the immense amount of information produced by satellite sensors.

GEOPHYSICAL SURVEY METHODS

REFER ALSO TO CITATION(S) 54363, 54454, 54458, 55935, 55936

55948 (AD-A—049125) **Subsurface exploration in alluvial terrain by surface geophysical methods. Final report.** Murphy, W.L. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)). Dec 1977. 85p. (WES-MP-S—77-24). NTIS PC A05/MF A01.

Field tests were conducted at several sites in Louisiana to determine the effectiveness of two geophysical tools for detecting and locating subsurface geological features in alluvial terrain. The hammer seismic refraction technique, using a hammer source and portable seismograph, and the surface electrical resistivity method, using a D.C.-powered resistivity meter and current source, were investigated. Seismic refraction lines and resistivity soundings and profiles were run concurrently at each site. Boring control was used where available to aid in interpretation of the geophysical data. The resistivity profiling (fixed electrode spacing) technique was the most successful of the three methods, detecting or locating the targeted geologic feature at three of the four sites tested. The resistivity sounding (expanding electrode spacing) technique delineated shallow features but was ineffective at depth. The hammer seismic technique also achieved only limited success at depth, attributed primarily to attentuation of the seismic signals by loose near-surface materials. Surveys were precluded at one site by the presence of certain man-made features that interfered with the collection of usable data.

55949 Electromagnetic method for locating underground anomalies. Lytle, R.J.; Laine, E.F.; Lager, D.L.; Davis, D.T. (to Department of Energy). US Patent Application 832,490. 12 Sep 1977. 11p.

Underground anomalies or discontinuities, such as holes, tunnels, and caverns, are located by lowering an electromagnetic signal transmitting antenna down one borehole and a receiving antenna down another, the ground to be surveyed for anomalies being situated between the boreholes. Electronic transmitting and receiving equipment associated with the antennas is activated and the antennas are lowered in unison at the same rate down their respective boreholes a plurality of times, each time with the receiving antenna at a different level with respect to the transmitting antenna. The transmitted electromagnetic waves diffract at each edge of an anomaly. This causes minimal signal reception at the receiving antenna. Triangulation of the straight lines between the antennas for the depths at which the signal minimums are detected precisely locates the anomaly. Alternatively, phase shifts of the transmitted waves may be detected to locate an anomaly, the phase shift being distinctive for the waves directed at the anomaly.

55950 Towards a more detailed seismic picture of the oceanic crust and mantle. Kennett, B.L.N. (Univ. of Cambridge, Eng.). *Mar. Geophys. Res.;* **3**: No. 1, 7-42(Jan 1977).

A review is presented of current interpretation techniques in marine refraction seismology with particular emphasis on those features which are most useful in structural studies using ocean bottom seismometers. Travel time analysis techniques are discussed for both refraction and variable angle reflection profiles and are compared with systematic travel time inversion methods. Amplitude and waveform analysis techniques allow a more detailed velocity depth profile to be determined, and are illustrated for both surface and bottom receivers. The study of anisotropy and lateral variations in crustal structure may be usefully combined using delay time function methods but a detailed structural model also requires velocity-depth information. Signal processing techniques which are particularly useful for shear wave and long range propagation studies are also mentioned. Structural studies using OBS' should lead to detailed knowledge of the oceanic crust and the P wave velocity distribution in the upper mantle.

55951 Calculation of resistivity sounding curves for a horizontally layered earth. Ushijima, K.; Ushijima, K. *Butsuri Tanko;* **30**: No. 1, 1-11(1977). (In Japanese).

A FORTRAN program PSH for the calculation of resistivity sounding curves for a horizontally layered earth is presented. A source list of the program with execution counts is shown and followed by an output example. The program was implemented on a large scale computer FACOM 230-45S, but it is so small in size that a geophysicist can easily make use of it on a mini-computer at his disposal. Resistivity sounding curves calculated by three programs, Argelo's, Onodera's and the one described here are compared.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 54345, 55942

55952 Diffraction of point-source signals by a circular crack. Achenbach, J.D.; Gautesen, A.K.; McMaken, H. (Northwestern Univ., Evanston, IL). *Bull. Seismol. Soc. Am.;* **68**: No. 4, 889-905(Aug 1978).

An analysis is presented of the diffraction by a hydraulically induced crack of time-harmonic signals emitted by a point source. Both diffraction by an empty crack and diffraction by a fluid-filled crack are considered. It is assumed that the crack is plane and of circular shape. The analysis is based on elastodynamic ray theory, which yields relatively simple approximations to the diffracted fields if ωa/c/sub L/ is sufficiently larger than unity, where ω is the circular frequency of the incident waves, a is the radius of the crack, and c/sub L/ is the velocity of longitudinal waves. The diffracted fields include direct diffractions from the crack edges as well as diffraction of signals which travel via the crack faces. The relative

magnitudes of these various contributions have been plotted. For three positions of the point of observation, numerical results for the three displacement components have been displayed in graphs.

55953 Bibliography of Canadian contributions in the field of rock mechanics. Weidmark, P.E. (Dept. of Energy, Mines, and Resources, Ottawa). *CIM Bull.;* **71**: No. 795, 108-110(Jul 1978).

55954 Geomechanics classification of jointed rock masses: mining applications. Laubscher, D.H. *Inst. Min. Metall., Trans., Sect. A;* **86**: A1-A8(Jan 1977).

The classification procedure for calculation of the in-situ rating of a jointed rock mass is described. A rating range, from 0 (very poor) to 100 (very good) is used to give the relative strengths. The need to ensure a good sampling of the area is stressed. The classification rating may be adjusted according to weathering, field and induced stresses, change in stress due to mining, the orientation and type of excavation with respect to geological structures and blasting effects. The in-situ and adjusted ratings are used for selection of the mining method for siting development and major excavations, for assessment of the support requirements and for the definition of cave angles and the extent of failure zones. Practical benefits based on case histories are discussed.

55955 Prediction of the state of stress of rock masses in the prospecting and construction stages of a mining enterprise. Popov, S.N. *Sov. Min. Sci. (Engl. Transl.);* **12**: No. 2, 140-144(Mar 1976).

Paper discusses two methods for determining the complete stress tensor, the first based on the use of a prospecting borehole and extraction of a borehole well core by drilling, the other based on the use of a mine shaft or other mine working and on the relief of a core from the central borehole.

55956 (UCRL-Trans—11377) **Results of using specific travel-time curves for determining the epicenters of certain regions of central Asia.** Butovskaya, E.M.; Zakharova, A.I.; Atabaev, Kh.A.; Flenov, Yu.P. Translated from *Byull. Sov. Seismol.;* No. 15, 101-111(1963). 20p. Dep. NTIS, PC A02/MF A01.

Travel-time curves and averaged profiles for the earth's crust have been obtained for three regions of Uzbekistan and its mountainous fringe, the Fergana Valley, Tashkent earthquake region, and central part of the Chatkal'skii Range. We have arbitrarily designated the Tashkent earthquake region as the portion of territory lying between 40°30′ to 42°30′ north latitude and 68 to 70° east longitude, and the extremities of the Pskemskii, Ugamskii and Chatkal'skii Ranges. We have also included, arbitrarily, in the central part of the Chatkal'skii Range, the portion of territory between 41 to 42°30′ north latitude and 71 to 73° east longitude, thus including a region north of the Fergana Valley in this area. The Fergana travel-time curve and averaged profiles are suitable for the territory from 40 to 41° north latitude and from 71 to 73° east longitude, but, according to the entire series of observations, we can expect that the travel-time curve found for this portion of territory is also suitable for the Central Tyan'-Shan' forelands of the Zaalaiskii Range. We obtained travel-time curves and averaged profiles mostly by processing recordings of powerful man-made explosions that were conducted in Uzbekistan in the period between 1952 and 1962 (11 explosions in all), but data from earthquake recordings were also taken into account.

OCEANOGRAPHY

REFER ALSO TO CITATION(S) 55862

55957 (SAND—78-0781C) **Development of multifunctional seafloor instrumentation systems.** Reece, E.W.; Stoller, H.M. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 34p. (CONF-780801—4). Dep. NTIS, MF A01.

From 13. intersociety energy conversion engineering conference; San Diego, CA, USA (20 Aug 1978).

Portions of document are illegible.

There is a recognized need in both government and industry for an expanded environmental hazards and engineering forces data base in the outer continental shelf, especially in frontier area. To help meet this need, Sandia Laboratories, under the sponsorship of DOE and USGS, has initiated a program to develop unique instrumentation systems which assist both government and industry to characterize the geotechnical environment of the OCS. A high data rate acoustic telemetry system together with a microcomputer controlled data acquisition processing and storage capability, has been developed and demonstrated. A Seafloor Earthquake Measurement System is being designed, and an initial prototype is being fabricated. A Geotechnically Instrumented Seafloor Probe which will assess the mudslide potential of submarine sediments is being designed, and a Marine Sediment Penetrometer which would provide shallow sediment strength profiles is being developed.

55958 (SRO—0639-18) **Flux of energy and essential elements through the continental shelf ecosystem. Progress report, July 1, 1977—September 30, 1978.** Pomeroy, L.R.; Wiebe, W.J. (Georgia Univ., Athens (USA). Inst. of Ecology). 15 May 1978. Contract EY-76-S-09-0639. 7p. Dep. NTIS, PC A02/MF A01.

During the current contract year we have actively pursued cooperative studies of Gulf Stream water over the continental shelf of the southeastern U.S. Biologically, the intrusions stimulate productivity just as do upwelling on western continental shelves. However, the intrusions move toward the coast (upwellings move away), displacing shelf water, and producing biological and other effects which extend far beyond the areas of intruded water. With the aid of the physical oceanographers, we have improved our ability to find intrusions for study, and we have followed several, each of which had a distinctive life history. We believe that intrusions have a major influence on the continental shelf ecosystem and deserve intensive study. They also provide an unusual opportunity for studies of succession in planktonic communities. Another major source of influence on the continental shelf ecosystem is flux of water out of rivers and estuaries. The movement of this low-salinity, high turbidity water in the low-energy environment of the Southeast Atlantic Bight is not well understood. We conducted a two-ship study of water movement in the near-shore zone off Wassaw Island, Georgia in cooperation with J.O. Blanton. During the current contract year we have completed data processing of the reconnaissance cruises of the southeastern continental shelf which were conducted with support of this contract during 1975 and 1976. The data summary is included as part of this report and will be made available also as a separate data report for wider distribution.

55959 Distribution of calcium carbonate in surface sediments of the Atlantic Ocean. Biscaye, P.E. (Columbia Univ., Palisades, NY); Kolla, V.; Turekian, K.K. *J. Geophys. Res.;* **81**: No. 15, 2595-2603(20 May 1976).

The areal distribution of calcium carbonate in the surface sediments of the Atlantic Ocean and adjacent seas and oceans is mapped on the basis of over 1700 data points. The first-order relation of carbonate distribution to water depth is evident in both the areal distribution and the plots of carbonate versus depth for 11 areas of the Atlantic. Superimposed on this relation are significant variations in both the 100% and the 0% $CaCO_3$ depth intercepts, analogous to the (calcite) lysocline and the (calcite) carbonate compensation depth, respectively. Variations in these critical parameters between the 11 areas are related to the three rate processes which control carbonate distributions: surface productivity, dissolution, and dilution by noncarbonate biogenic and nonbiogenic sediment. The areal distribution of carbonate in surface sediments is compared with that in sediments deposited at the end of the last glacial epoch, 18,000 yr B.P., carbonate abundance was markedly lower.

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

55960 (COO—1198-1211) **High pressure as a basic variable in modern science and technology.** Drickamer, H.G. (Illinois Univ., Chicago (USA)). 1978. Contract EY-76-C-02-1198. 6p. Dep. NTIS, PC A02/MF A01.

A brief outline is given of some of the ways that pressure has been important to the understanding of nature. High pressure research for the understanding of the behavior of matter intrinsically at high pressure or to obtain states of matter or chemical combinations which are not obtainable or not stable at atmospheric pressure as well as for the effect of pressure on the electronic states and physical and chemical properties of matter to provide a better characterization of these states and properties or to test theories concerning properties and processes occurring at one atmosphere to predict phenomena occurring under a change to ordinary conditions is discussed. Earth studies, solids, chemical reactions, and astrophysics are noted in these regards. (JFP)

55961 Direct-simulation neutrino transport: Aspects of equilibration. Tubbs, D.L. (Department of Physics and the Enrico Fermi Institute, The University of Chicago). *Astrophys. J., Suppl. Ser.;* **37**: No. 3, 287-312(Jul 1978).

A direct numerical simulation of neutrino transport using Monte Carol techniques is presented. The method has been applied to neutrino transport in energy space, using an infinite, uniform, homogeneous medium of free electrons, neutrinos, and nucleons at constant temperature and baryon density. The composition is determined through the electron number per baryon, which is given the

initial values of Y/sub e/° = 0.4 and 0.2; the particle compositions are changed via the reactions e⁻ parrow-right-left ν/sub e/n, from zero neutrino losses in equilibration is included as a simple energy-dependent neutrino lifetime which follows an exponential distribution. Temperature and density are studied in the ranges 10< or = T_9(10⁹ K) < or = 100 and 10^{10} < or = rho (g cm^{-3}) < or = 10^{13}. The baryons are assumed to be nonrelativistic and nondegenerate. The electrons are relativistic, and the neutrino-electron scattering has been carefully treated, and is valid at arbitrary electron and neutrino degeneracies. Analysis of this interaction shows that low-energy neutrinos (E/sub ν/ < μ/sub e/, the electron chemical potential) can suffer large energy gains relative to losses from scattering with electrons. Within the context of the physical assumptions used, the Monte Carlo results indicate that neutrino-electron scattering had a negligible influence on neutrino equilibration. The possible effect of scattering is to increase the rate of equilibration by population of lower-energy states. Results suggest that neutrino-matter equilibrium is likely for rho> or ≈ 10^{12} g cm^{-3}; equilibration times are much smaller than dynamical and diffusion times at such densities. The neutrinos are unable to achieve thermodynamic equilibrium for rho< or ≈ 10^{11} g mc^{-3}, and may be unable to maintain a nonequilibrium steady-state distribution over dynamical time scales. Energy exchange between neutrinos and nucleons may be as important as energy exchange with electrons, and is under investigation.

COSMIC RADIATION

55962 (AD-A—050563) **Theoretical models and numerical estimates of acoustic signals of high-energy cosmic particles in the ocean. Survey report.** Hanish, S. (Naval Research Lab., Washington, DC (USA)). 15 Dec 1977. 83p. (NRL—8150). NTIS PC A05/MF A01.

The generation of acoustic noise by deceleration of high-energy elementary particles in liquids has been documented in several publications by various groups of physicists, who have also provided tentative models for understanding and prediction. In this report several theoretical models are rederived, assembled, and compared, and further development is undertaken on a selected few. Numerical calculations are made in the specific cases of muons and neutrinos, and conclusions are drawn as to the conditions under which the noise of cosmic particles in the ocean can be detected by hydrophones.

55963 Further measurements and reassessment of the magnetic-monopole candidate. Price, P.B.; Shirk, E.K.; Osborne, W.Z.; Pinsky, L.S. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., D;* **18**: No. 5, 1382-1421(1 Sep 1978).

Within the stack, consisting of 35 Lexan detectors and three nuclear emulsions, in which the unusual event was found, we have measured tracks of ~ 200 cosmic-ray nuclei with 26 < or = Z < or = 83, which provide an internal calibration of the response of the detectors. Our measurements in Lexan and in emulsion together show that the unusual particle produced a knockon-electron energy distribution incompatible with any known nucleus. The track etch rate and its gradient in Lexan give the quantity vertical-barZvertical-bar/β and, if the particle was a nucleus, a lower limit on its velocity. We found vertical-barZvertical-bar/β ≃ 114 at each of 66 positions in the Lexan stack extending over a range of ≃ 1.4 g/cm^2. The best fit to the Lexan data alone would be for a hypothetical superheavy element with Z ≃ 108 to 114 and β such that Z/β ≃ 114. A known nucleus with 90 < or = Z < or = 96 would also give an acceptable fit to the Lexan data if it fragmented once in the stack with a loss of about 2 units of charge, keeping Z/β ≃ 114. A nucleus with Z < 90 could maintain Z/β ≃ 114 only by a properly spaced set of fragmentations. A nucleus with β as low as 0.6 could fit the Lexan data only if it fragmented at least eight times in succession, with a probability ~ 10^{-17}. In the 200-μm G-5 emulsion, visual measurements of the track "cores" produced by relatively-low-energy electrons (< or ≈ 10 keV) are consistent with the Lexan result that the unusual particle had vertical-barZvertical-bar/β ≃ 114. However, measurements of the density of silver grains at radial distances greater than ~ 10 μm show that the particle produced far fewer high-energy (> or ≈ 50 keV) knockon electrons in each of the three emulsions than would a known nucleus with Z/β = 114.

STARS

55964 Reply to "Use of chiral symmetry in pion-condensation calculations". Campbell, D.K.; Dashen, R.F.; Manassah, J.T. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., D;* **18**: No. 4, 1343-1346(15 Aug 1978).

We review our earlier results on the role of chiral symmetry in pion condensation and show how they are completely consistent with Sawyer's observations in the preceding comment.

55965 Self-similar adiabatic motions of a self-gravitating gas in a star. Bogoyavlenskii, O.I. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 2, 83-85(20 Jan 1978).

New solutions of the problem of explosion of a star are obtained. All the asymptotic forms of the self-similar accretion of the gas to the center are derived. Exact solutions with a converging shock wave are indicated.

55966 Distribution of photometric classes of type I supernovae with respect to the morphological type of the parent galaxy. Pskovskii, Y.P. (Shternberg Astronomical Institute, Moscow). *Sov. Astron. Lett. (Engl. Transl.);* **4**: No. 1, 10-11(Jan 1978).

Type I supernovae of all photometric classes are observed in type Sb—Sc spiral galaxies. Those of the junior classes I.6—I.8 occur exclusively in these systems. Type E, S0, and Sa galaxies with their large spherical subsystems contain supernovae of the intermediate classes I.9—I.10, and a few of the senior classes I.12—I.14. Only the senior classes are found in irregular (Magellanic-type) systems. The photometric class is indicative of the expansion velocity of the supernova envelope, which in turn is probably related to the mass.

55967 Nonsteady accretion of stellar wind. Syunyaev, R.A. (Institute for Space Research, USSR Academy of Sciences, Moscow). *Sov. Astron. Lett. (Engl. Transl.);* **4**: No. 1, 39-42(Jan 1978).

The accretion of low-velocity (ν<300km/sec) stellar wind by neutron stars could be a nonsteady process and might be responsible for such phenomena as transient x-ray sources and x-ray bursters.

55968 Turn-off of the reflection effect in the HZ Herculis system. Bisnovatyi-Kogan, G.S.; Bochkarev, N.G.; Karitskaya, E.A.; Cherepashchuk, A.M.; Shakura, N.I. (Institute for Space Research, USSR Academy of Sciences of the USSR Moscow, Astronomical Council, Academy of Sciences of the USSR Moscow, and Shternberg Astronomical Institute, Moscow). *Sov. Astron. Lett. (Engl. Transl.);* **4**: No. 1, 43-46(Jan 1978).

Some possible photometric effects from the ellipsoidality of the optical component in he HZ Her system (Her X-1) and from eclipse by the disk surrounding the neutron star are calculated and discussed, insofar as they might be detectable during periods when the reflection effect in this system is absent.

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

55969 RATAN-600 observations of radio sources at 13 cm. Kirakosyan, R.M.; Malumyan, V.G. (Institute of Radiophysics and Electronics, Academy of Sciences of the Armenian SSR, Ashtarak). *Sov. Astron. Lett. (Engl. Transl.);* **4**: No. 1, 3-4(Jan 1978).

Preliminary flux density measurements are reported for about 20 variable and suspected variable radio sources, as well as observations of the central part of Centaurus A. These observations were made in September—October 1976 at λ=13 cm with the north array of the RATAN-600 radio telescope. The components of the central double source in Cen A have angular diameters of 2'.40 +- 0'.13 and 1'.50 +- 0'.16. The flux ratio of the west and east components is the same, 0.75 +- 0.05, as at shorter wavelengths.

SOLAR PHENOMENA

55970 (AD-A—050483) **Compilation of scientific results from the satellite OV1-17. Final report.** Rugge, H.R. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 2 Dec 1977. Contract F04701-77-C-0078. 320p. NTIS PC A14/MF A01.

This compilation consists of all scientific papers based on data obtained wholly, or in part, from experiments flown on the OV1-17 satellite. The total number of papers is severely limited because only three of the seven Aerospace experiments on board OV1-17 were able to obtain any useful data as a result of the inability of the satellite to achieve proper orientation. Even these three experiments received useful data for only relatively short time periods. In addition to the scientific papers, a brief description of the OV1-17 satellite is included.

55971 (AD-A—050642) **Significant solar proton events, 1955-1969. Interim report.** Shea, M.A.; Smart, D.F. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1 Feb 1978. 18p. (AFGL-TR—78-0028). NTIS PC A02/MF A01.

A list of the significant solar proton events for the period 1955 through 1969 has been prepared with identification limited to events with solar proton-induced absorption as measured by a riometer in the earth's polar caps. A total of 139 events were identified over this 15-year period. This table was compiled after a thorough search of primary data sources in order to ascertain an onset time, a time of maximum absorption, the value of the maximum absorption, and the duration of each event. The observing location is identified for each of the events.

55972 (NTIS/PS—78/0241) **Solar eclipses (a bibliography with abstracts). Report for 1964-Feb 78.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 168p.

The bibliography cites observations of solar radiation, solar corona, and effects on the earth's atmosphere taken during solar eclipses. Observations from the eclipses of 1961 through 1973 are included. (This updated bibliography contains 163 abstracts, 3 of which are new entries to the previous edition.)

55973 (PB—278143) **Solar—geophysical data number 401, January 1978. Part I (prompt reports). Data for December 1977—November 1977.** Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Jan 1978. 119p. (SGD—301-Pt-1). NTIS PC A06/MF A01.

This prompt report provides data for December 1977 on alert period, daily solar indices, solar flares, solar radio waves, solar x-ray radiation, coronal holes, solar wind measurements, inferred IP magnetic field polarities, and mean solar magnetic field. It also provides data for November 1977 on daily solar activity center, sudden ionospheric disturbances, solar radio waves, cosmic rays, geomagnetic indices, and radio propagation indices.

55974 (PB—278144) **Solar—geophysical data number 401, January 1978. Part II. (comprehensive reports). Data for July 1977—June 1977 and miscellanea.** Coffey, H.E. (National Geophysical and Solar-Terrestrial Data Center, Boulder, CO (USA)). Jan 1978. 52p. (SGD—401-Pt-2). NTIS PC A04/MF A01.

This comprehensive report for July 1977, June 1977 and Miscellaneous data provides data on active regions, synoptic solar maps, solar flares, solar radio waves, energetic solar particles and plasma, synoptic chart, abbreviated calendar record, regional flare index, solar radio waves, and cosmic rays.

55975 **Ion-acoustic-like instabilities in the solar wind.** Gray, S.P. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *J. Geophys. Res.;* **83**: No. A6, 2504-2510(1 Jun 1978).

The linear dispersion properties of k parallel to B electrostatic instabilities driven by an electron heat flux or an ion beam are studied by use of parameters appropriate to average values in the solar wind near 1 AU. These modes are also compared with field-aligned electromagnetic instabilities driven by the same sources of free energy. The ion acoustic heat flux instability has a high threshold relative to the whistler heat flux instability, so the latter mode is the more likely cause of the heat flux limitation near 1 AU. However, at sufficiently large T/sub e//T/sub t/ the electrostatic ion beam instability threshold is of the same order as that of the magnetosonic ion beam instability, implying that the former is the more likely source of ion acoustic-like fluctuations observed near 1 AU.

55976 **Method for determining the large-scale magnetic field in the solar corona.** Ruzmaikin, A.A.; Sokolov, D.D. (Institute of Applied Mathematics, Academy of Sciences of the USSR, Moscow). *Sov. Astron. Lett. (Engl. Transl.);* **4**: No. 1, 12-14(Jan 1978).

A method for determining the coronal field is proposed, involving repeated measurement of the Faraday rotation of discrete sources projected against the corona. The magnetic field is evaluated by solving a Fredholm integral equation of the first kind by Tikhonov's method. A simple estimate is made of the expected solution, and 42 radio sources suitable for an observing program are listed.

55977 **Entropy and the spontaneous emission of plasma waves.** Grognard, R.J.M. (COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, EPPING (AUSTRALIA). DIV. OF RADIOPHYSICS). *Proc. Astron. Soc. Aust.;* **82**: 174-177(Sep 1977).

The emission of plasma waves by beams of electrons travelling in a plasma is a phenomenon of critical importance in applied plasma physics and also astrophysical research, e.g. in the theory of solar radio bursts. In the article the author develops a correct entropy theorem for the beam-plasma system whose interactions are described by the set of quasi-linear equations including spontaneous emission terms. The role and interplay of the induced and spontaneous emission of plasma waves and their effects on the streaming electrons are thereby greatly elucidated. The analysis shows that the spontaneous terms simply cannot be neglected.

COSMOLOGY

55978 **Quantum effects and the Friedman model.** Gurovich, V.T. (Institute of Physics and Mathematics, Academy of Sciences of the Kirgiz SSR). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 193-197(Aug 1977).

Quantum effects near a singularity lead to multiparticle production and vacuum polarization. The vacuum polarization gives rise to various kinds of nonlinear additions in the four-curvature in the Lagrangian of the gravitational field. In the case of an isotropic cosmological model, their local part can be written in the form ΔL/sub g/=A +BR²+CR² Invertical-barRvertical-bar, (R=g/sub i/kR/sup i/k). It is shown that allowance for ΔL/sub g/ in the Friedmann model gives a regular minimum of the scale factor b_0; out of this minimum, there emanate two solution branches with decreasing and increasing value of vertical-barRvertical-bar. Because of the change in the sign of the logarithm, the first branch goes over into an oscillatory regime; the second gives a divergence of R as $b \to \infty$. In this case, the solution b (t), which has a regular minimum, approaches the Friedmann behavior in the asymptotic limit $t \to \infty$, and the singularity is displaced to the opposite end of the time axis. Allowance for particle production or inclusion of viscosity near b_0 may restrict the growth of the curvature in the second solution branch, and the universe may then approach the Friedmann solution in the limit $t \to \infty$ as well.

55979 (NTIS/PS—78/0089) **Cosmology (a bibliography with abstracts). Report for 1964—January 1978.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Feb 1978. 145p. NTIS PC N01/MF N01.

Studies of cosmology and cosmological models are cited. The origin of the universe is studied by the aid of nuclear reactions, relativity, and astrophysical research. (This updated bibliography contains 140 abstracts, 11 of which are new entries to the previous edition.)

PLANETARY PHENOMENA

55980 (CONF-780314—6) **Impact-melt origin for the Simondium, Pinnaroo, and Hainholz mesosiderites: implicatiions for impact processes beyond the Earth—Moon system.** Floran, R.J.; Caulfield, J.B.D.; Harlow, G.E.; Prinz, M. (Oak Ridge National Lab., TN (USA); American Museum of Natural History, New York. Dept. of Mineral Sciences; City Coll., New York (USA). Dept. of Earth and Planetary Sciences). May 1978. Contract W-7405-ENG-26. 53p. Dep. NTIS, PC A04/MF A01.

From 9. lunar science conference; Houston, TX, USA (Mar 1978).

The Simondium, Pinnaroo, and Hainholz mesosiderites are interpreted to be clast-laden impact melts that crystallized from immiscible silicate, metallic (Fe-FeS) liquids. The existence of silicate melts is shown by intergranular basaltic textures. Metallic melts are inferred on the basis of smooth boundaries between metal and troilite and the occurrence of troilite as anastomosing areas that radiate outward into the silicate fractions. These relations suggest that troilite crystallized after silicates, concentrating as a late-stage residuum. Evidence for impact melting includes: diversity and abundance of clast types (mineral, metal, lithic) in various stages of recrystallization and assimilation; differences in mineral chemistries between clasts and igneous-textured matrix silicates; unusual metal plus silicate bulk composition. Silicate clasts consist primarily of orthopyroxene and minor olivine with a range of Fe/Fe + Mg ratios, anorthitic plagioclase, and rare orthopyroxenite (diogenite) fragments. Substantial amounts of Fe-Ni metal were melted during the impact events and minor amounts were incorporated into the melts as clasts. The clast populations suggest that at least four rock types were melted and mixed: (a) diogenite, (b) a plagioclase-rich source, possibly cumulate eucrite, (c) dunite, and (d) metal. Most orthopyroxene appears to have been derived from fragmentation of diogenites. Orthopyroxene (En/sub 82-61/) and olivine (Fo/sub 86-67/) clasts include much material unsampled as individual meteorites and probably represent a variety of source rocks.

55981 **Model of comet comae. I. Gas-phase chemistry in one dimension.** Giguere, P.T.; Huebner, W.F. (Theoretical Division, T-4, Los Alamos Scientific Laboratory). *Astrophys. J.;* **223**: No. 2, 638-654(15 Jul 1978).

A model of gas-phase chemical kinetics in comet comae has been developed. Its purpose is to allow characterization of comet nuclei by predicting abundances of observable coma species. The one-dimensional calculation follows an isothermal shell of outstreaming molecules, positive ions, and atoms that starts at the nucleus with a simple set of mother molecules. Rate equations for 441 photo and chemical reactions are solved simultaneously at many points in the expansion of the shell. The calculation includes effects of the ultraviolet opacity of the mother molecules. Results are presented for four combinations of hypothetical mother molecules :H_2O, CO_2, NH_3, and CH_4. Several species that are not simple photodestruction products of the mother molecules reach large abundances. CO^+, C_2, C_3, HCN, N_2^+, and (probably) CN are underproduced by the model. Additional sources for these species are discussed.

55982 **Some problems concerning the accumulation of planets.** Levin, B.Y. (Astronomical Council, Academy of Sciences of the USSR Moscow). *Sov. Astron. Lett. (Engl. Transl.);* **4**: No. 1, 54-57(Jan 1978).

The random velocities of the planetesimals in the protoplanetary swarm are shown to have been much lower than hitherto

believed on the basis of V. S. Safronov's analysis. Some modification should therefore be made in O. Yu. Shmidt's scheme for the growth of the planets from material in the zones feeding them. The present author's 1972 arguments for a protoplanetary nebula with a massive, extended periphery are no longer tenable.

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

55983 (AD-A—049057) **Low altitude plasma line anisotropy. Interim report.** Oran, E.S.; Palmadesso, P.J. (Naval Research Lab., Washington, DC (USA)). Oct 1977. 19p. (NRL-MR—3584). NTIS PC A02/MF A01.

Plasma line observations obtained from incoherent radar backscatter have been used as a ground-based method for deriving information about the size and anisotropy of the ionospheric photoelectron fluxes. In the past data interpretation has been confined to altitudes above the F2 peak. Measurements below the F2 peak consistently show an anisotropy in the ratio of the downshifted to upshifted amplitudes of 20-50% when it is generally assumed that diffusion processes dominate. Calculations of the plasma line intensity are described which use a multi-angle multi-energy calculation of the photoelectron distribution function. The calculated electron flux exhibits a low-altitude, low-energy anisotropy which is reflected in the plasma line measurements. Given anisotropic elastic electron-neutral cross-sections, the flux anisotropy arises when the local mean free path is of the order of the local scale height. The net effect is conversion of a spatial density inhomogeneity into a velocity distribution anisotropy.

55984 (AD-A—049066) **Auroral simulation effects. Final report, 1 November 1975—31 March 1977.** Archer, D.H.; Tarr, P.W. (Mission Research Corp., Santa Barbara, CA (USA)). 31 Mar 1977. Contract DNA001-76-C-0138. 130p. (MRC-R—313; DNA-HAES—62). NTIS PC A07/MF A01.

This report describes the continuing and concluding work related to analyses of ICECAP data with emphasis on short-wavelength infrared radiation in the auroral environment. A brief description of some satellite-communications related work is also included. Data from two auroral events, taken by ICECAP rockets IC 519.07-B and IC 507.11-2A, were analyzed and compared with results from computer calculations. These comparisons, along with those from earlier studies, are used to draw conclusions and recommendations related to IR modeling in the nuclear environment. A new and more accurate procedure for calculating electron temperatures was devised and incorporated into the auroral code ARCTIC. The results were used, along with ion mass spectrometer measurements in an aurora, to infer enhanced values for the NO concentration.

55985 (AD-A—049115) **Collisionless effects on the spectrum of secondary auroral electrons at low altitudes. Interim report.** Papadopoulos, K.; Rowland, H.L. (Naval Research Lab., Washington, DC (USA)). Oct 1977. 22p. (NRL-MR—3637). NTIS PC A02/MF A01.

It is shown by use of particle computer simulations that collisionless interactions, due to energetic electron precipitation in the auroral zones, can be responsible for the break from the E^{-3} dependence of the secondary electron spectrum expected on the basis of collisional models, even at very low altitudes (<180 km).

55986 (AD-A—050256) **'INVERT', a computer program for obtaining D-region electron density profiles from vlf reflection coefficients. Research report.** Morfitt, D.G.; Shellman, C.H. (California Univ., Davis (USA). Dept. of Land, Air, and Water Resources). 30 Nov 1977. Contracts DNA-MIPR-77-521;DNA-MIPR-78-504. 188p. (NOSC/IR—782). NTIS PC A09/MF A01.

INVERT is a FORTRAN computer program designed to study the feasibility of obtaining electron density distributions of the D-region of the ionosphere. These electron density profiles would be derived from measurements of ionospheric reflection coefficients. The radio propagation frequencies would be limited to the VLF band, particularly 3-20 kHz. This report contains a discussion of the analytical approach taken in INVERT, a FORTRAN listing of the program, instructions for using the program and some sample calculations using simulated data. The program has not been used with real data.

55987 (AD-A—050293) **A technique for obtaining D-region electron density profiles from vlf reflection coefficients. Research report.** Morfitt, D.G.; Shellman, C.H. (California Univ., Davis (USA). Dept. of Land, Air, and Water Resources). 16 Nov 1977. Contracts DNA-MIPR-77-521;DNA-MIPR-78-504. 88p. (NOSC/IR—781). NTIS PC A05/MF A01.

A technique is described for determining D-region electron density profiles from VLF reflection coefficients. Some of the problems concerning convergence of the iterative scheme are discussed as well as the constraints introduced to account for features of the profile for which information is not provided by reflection coefficient data. An example is given where the technique is applied using simulated data.

55988 (AD-A—050606) **Ionospheric electron production rate for grazing incidence at the Ebro observatory. Scientific report no. 6 (final), Aug 73—Jul 74.** Alberca, L.F. (Observatorio del Ebro, Tortosa (Spain)). 29 Dec 1977. 67p. NTIS PC A04/MF A01.

Values of total electron content of the ionosphere, obtained at the Observatorio del Ebro by the Faraday rotation method, have been analyzed to study electron production rates. Daily values of the electron production rate, integrated with respect to height through the ionosphere, were determined at sunrise for the period August 1973-Jul 1974, by a method that makes use of a two-component model atmosphere. A Fourier analysis of the results indicates an annual and a semiannual variation of the production rate values. A comparison with results of other authors seems to indicate a latitudinal dependence of the semiannual variation; no similar effects was found for the annual variation.

55989 (AD-A—050647) **Study of the equatorial ionosphere: the equatorial evening minimum in the total electron content of the ionosphere and its role in equatorial scintillation. Final report 1 Jan 74—30 Sep 77.** Koster, J.R. (Ghana Univ., Legon. Dept. of Physics). 30 Nov 1977. 34p. NTIS PC A03/MF A01.

A minimum in the total electron content of the equatorial ionosphere frequently appears shortly after sunset in measurements of Faraday rotation made at Legon, Ghana (latitude 5.63 deg N, longitude -0.19 deg E, magnetic dip 8 deg S). This paper describes the phenomenon and investigates its occurrence characteristics over a period of six years. It concludes that the effect is due to a transport phenomenon described as a 'circulation cell' which follows the sunset line. This circulation is not considered to be the primary cause of the production of irregularities in the nighttime F region, but the mechanism is thought to contribute to both the intensity and the duration of the resulting scintillation.

MAGNETOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 55973

55990 (AD-A—049086) **Vlf transmission induced slot electron precipitation. Interim report.** Vampola, A.L. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 5 Dec 1977. Contracts F04701-77-C-0078;NAS5-22450. 19p. NTIS PC A02/MF A01.

Analysis of electron observations in the drift and bounce loss cones of the slot region of the magnetosphere indicates that the predominant mode in which electrons in the 100 to 400 keV energy range arrive in the drift loss cone is via discrete events. These events are usually traceable back to the vicinity of a high-power-level VLF transmitter. No gradual buildup of electron flux, proceeding eastward from the South Atlantic Anomaly, is observed. Estimates of the loss rate due to the discrete events show that this process can result in a depletion of 50% per day of the electron flux in the slot region. The wave-particle interaction must occur relatively low on the field line (lambda approximately 30 deg to 50 deg) because of the relationship of particle energies and wave frequencies involved. Additional scattering of the particles near the equator, either by power-line harmonic emissions or naturally occurring ELF hiss, is required to transport the particles to the lower interaction region.

55991 (AD-A—050172) **Use of interplanetary radio scintillation power spectra in predicting geomagnetic disturbances. Final report Jun 76—Sep 77.** Roelof, E.C.; Gotwols, B.L.; Mitchell, D.G.; Cronyn, W.M.; Shawhan, S.D. (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). 31 Oct 1977. Contracts N00017-72-C-4401;MIPR-FY-7121-76-00012. 42p. NTIS PC A03/MF A01.

An investigation of the feasibility of using interplanetary scintillations (IPS) of cosmic radio sources for prediction of geomagnetic disturbances has been carried out based on observations taken May-December 1974 and May-August 1976. The 1974 observations were taken with the University of Iowa COCOA-Cross array at 34.3 MHz located at Clark Lake Radio Observatory near Borrego Springs, California, and synoptic data on 33 sources were reduced to yield scintillation index (band-pass integrated IPS power) for each source. In 1976, COCOA-Cross observations at 34.3 MHz were supplemented by 38 MHz observations from the University of Maryland TPT array, also at Clark Lake, and the high-time-resolution data were reduced to obtain IPS power spectra from 0.1 to 3 Hz. From detailed analyses of both data sets, the authors conclude that IPS prediction of the onset of geomagnetic disturbances may be feasible with a lead time of about one day.

55992 (AD-A—050585) **Magnetosheath effects on cylindrical Langmuir probes. Interim report.** Szuszczewicz, E.P.; Takacs, P.Z. (Naval Research Lab., Washington, DC (USA)). Dec 1977. Contract NASA-W-14252. 33p. (NRL-MR—3683). NTIS PC A03/MF A01.

The response of cylindrical Langmuir probes in magnetoplasmas is studied from a new perspective which focuses on the relative magnitudes of Larmor radius and sheath size. The approach results in a more meaningful classification for magnetic field effects, which are defined as weak-, strong-, and transitional-magnetosheath. Specific classification guidelines are established that involve not only the magnetic field strength but also the plasma parameters of density and temperature, and the applied probe potential. A 0.25 gauss field can have similar effects on a probe's current collection properties in an ionospheric plasma N/sub e/ approx. = 1,000,000 cm^{-3} as a 30 kgauss field would have in a hot, dense laboratory plasma N sub e approx. = 10^{15} cm^{-3}. The magnetosheath classifications are found to agree with new experimental results collected in an ionospheric plasma. The data also show that electron current suppression is as much a function of field strength as sheath size, an important detail not included in existing theoretical models.

55993 (AD-A—050637) **Signature of a parallel electric field in ion and electron distributions in velocity space. Interim report.** Croley, D.R. Jr; Mizera, P.F.; Fennell, J.F. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 6 Feb 1978. Contract F04701-77-C-0078. 21p. (TR—0078(3960-5)-5). NTIS PC A02/MF A01.

Charged-particle data taken by the S3-3 satellite are presented as contours of the velocity distribution function on a velocity-space diagram. This report focuses on the analytical technique used to interpret the particle data. Details of features exhibited by the electron and ion data in the velocity space representations are discussed in terms of a simple electrostatic acceleration model. The observed particle populations are separated in velocity-space by recognizable demarcations calculated from the conservation laws in accordance with Liouville's theorem.

55994 (AD-A—050640) **Satellite observations of polar, magnetotail lobe, and interplanetary electrons at low energies. Interim report.** Mizera, P.F.; Fennell, J.F. (Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.). 20 Jan 1978. Contract F04701-77-C-0078. 33p. NTIS PC A03/MF A01.

Low-altitude satellite observations of the low-energy electron fluxes that populate the polar regions are summarized and classified into two groups: the very low intensity distributions and the more intense, often structured distributions observed during magnetically disturbed conditions. High-altitude observations of electron fluxes, including the solar wind and the tail lobes, are presented to suggest that the first type of observations are the result of direct access of interplanetary electrons through the lobes into the polar regions. The letter observations may be due in part to magnetospheric processes.

55995 **Plasma sheet pressure anisotropies.** Stiles, G.S.; Hones, E.W. Jr; Bame, S.J.; Asbridge, J.R. (University of California, Los Alamos Scientific Laboratory Los Alamos, New Mexico 87545). *J. Geophys. Res.;* **83**: No. A7, 3166-3172(1 Jul 1978).

The ecliptic plane components of the pressure tensors for low-energy (<keV) electrons and protons have been examined for more than 400 hours of quiet time plasma sheet data from Imp 6 and Imp 8. Individual high time resoluion (< or ≈100 s) measurements show that while at times the tensors may be clearly anisotropic with the pressure parallel to the magneti field (P/sub parallel/) being as much as 1.5-2.0 times the pressure perpendicular (P/sub perpendicular/), the anisotropies are not usually of this magnitude and are typically below the value thought necessary to balance the tension of the magnetic field. One-hour averages of the particle counts have also been calculated. While these averages mask more rapid changes due to variations in the distributions and the magnetic field and can yield only a lower limit to the true anisotropy, examinations of the individual measurements indicate that they do provide a reasonable summary. On this time scale, the protons are nearly isotropic: the ratio of the maximum ecliptic component of the proton pressure tensor to the minimum is typically < or ≈1.1, and there is no apparent tendency for the distributions to be field aligned. On the same time scale, the electron distributions do show a tendency to be field aligned with P/sub parallel//P/sub perpendicular/> or =1.2 approximately 25% of the time. Due to the low energy density of the electrons, however, this anisotropy is not itself sufficient to balance the tension of the magnetic field.

55996 **Characteristics of energetic electrons in the vicinity of the magnetospheric boundary layer at Vela orbit.** Palmer, I.D.; Hones, E.W. Jr. (Oral Roberts University, Tulsa, Oklahoma 74171). *J. Geophys. Res.;* **83**: No. A6, 2584-2596(1 Jun 1978).

A study is made of intensity and anisotropy characteristics of energetic electron populations (> or ≈30 KeV) near the magnetotail surface at the Vela orbit (r≅18 R/sub E/). Inferring from a unidirectional (ξ/sub u/) or bidirectional (ξ/sub b/) anisotropy of the electron flux that the electrons are on open or closed magnetic field lines, we find that the field lines in the magnetospheric boundary layer adjacent to the plasma sheet were closed in about one third of the boundary layer crossings studied and were open in about one eighth of those crossings. No closed field lines can be inferred for the boundary layer crossings contiguous to the high-latitude tail (lobe), but open field lines are inferred for a few such crossings. These observations support the idea that closed boundary layer flux tubes are swept from the subsolar surface of the magnetosphere along its flanks and into the tail and that the plasma sheet is generated at least in part by the incorporation of these closed flux tubes into the tail. Electron intensities in the portion of the boundary layer contiguous to the plasma sheet were less by a factor of ~2.5 than those within the plasma sheet and greater than those in the neighboring magnetosheath by about the same factor. Thus the plasma sheet is probably the source of the electrons in these regions. But electron intensities in the boundary layer adjoining the tail lobewith the magnetospause were less by a factor of ~2 than those in the neighboring magnetosheath, suggesting that the magnetosheath is the source in these regions. In the magnetosheath, highly collimated beams (ξ/sub u/> or ≈1.0) of energetic electrons are seen near the magnetopause, most commonly on the duskside, and occur less than 25% of the time in which significant fluxes are measured. The beams are sporadic, lasting typically 5-30 min., and are aligned with the magnetopause.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

55997 (AD-A—048852) **Indirectly funded research and exploratory development at the Applied Physics Laboratory, fiscal year 1976. Annual report, 1 October 1975—30 September 1976.** Hart, R.W. (Johns Hopkins Univ., Silver Spring, MD (USA). Applied Physics Lab.). Jul 1977. Contract N00017-72-C-4401. 193p. (APL/JHU/SR—77-2). NTIS PC A09/MF A01.

Subject areas reported on include the following: Applied Analysis; Applied Mathematics; Atomic, Molecular, and Electronic Physics; Chemical Physics; Microwave Physics; Quantum Electronics and Excitation Mechanisms; Solid-State Physics; and Exploratory Development -- Box launcher development, Feasibility demonstration, automated maintenance support tool; Kinematic performance of an advanced missile, Space research and technology, Satellite-aided search and rescue system, Global positioning system package, Support of biomedical engineering, Computer-aided hemodynamic monitoring unit, Ocean thermal energy system, Copper sulfide/cadmium sulfide solar cells, Automotive pollution reduction by water injection, Vessel traffic system, and Air traffic safety and control.

55998 **Covariant photon interaction in atomic physics.** Huang, K. (Behlen Laboratory of Physics, University of Nebraska, Lincoln, Nebraska 68588). *Phys. Rev., A;* **18**: No. 3, 1119-1123(Sep 1978).

The covariant photon interaction between electrons is reviewed briefly. Its potential function in configuration space is obtained unambiguously in a covariant perturbation calculation. Several different forms are presented, and their applications in atomic physics are discussed. In addition, the general matrix elements of various potential functions are given in terms of radial integrals, suitable for numerical computations.

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 55456, 55512

55999 **g/sub J/ factor of metastable $^5S_2$ atomic oxygen using a time-of-flight, atomic-beam magnetic-resonance method.** Incesu, T.; Huq, A.; Shugart, H.A. (Department of Physics and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., A;* **18**: No. 3, 797-801(Sep 1978).

A time-of-flight, atomic-beam magnetic-resonance method was used to compare the g/sub J/ factor of $2p^33s$ $^5S_2$ atomic oxygen with the g/sub J/ factor of metastable 2 $^3S_1$ atomic helium in magnetic fields of 3209 and 4228 G. The metastable oxygen and helium atoms were produced in a pulsed radio-frequency discharge source and after traversing the apparatus were detected by electron emission from a tungsten surface. By collecting data only in a given interval of the time-of-flight distribution the O(^{5}S) and He(^{3}S) states were isolated from other discharge products. From 158 pairs of resonances taken with four relative field and hairpin orientations the atomic magnetic g factor is g/sub J/($^5S_2$,^{16}O) = μ/sub J//J = -2.002 091 0(10).

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 55631

56000 (AD-A—050156) **Coherent anti-Stokes Raman scattering of molecular gases. Final report 1 Mar 75—30 Apr 77.** Roh, W.B. (Systems Research Labs., Inc., Dayton, OH (USA). Research Appli-

cations Div.). Aug 1977. Contract F33615-75-C-1116. 106p. (SRL—6856). NTIS PC A06/MF A01.

An experimental system based upon a single-mode ruby laser and a ruby-pumped dye laser has been developed to investigate coherent anti-Stokes Raman scattering (CARS) of molecular gases. The CARS system is capable of both broad- and narrow-band operation. Theoretical and experimental results obtained using this system for such gases as H_2, HF, CO, N_2, and CH_4 are given. In particular, real-time CARS spectra of these gases have been obtained for rotational temperature estimations, and the pressure dependence of integrated CARS intensity has been determined. In addition, the effect of media turbulence upon laser-beam propagation and upon the CARS process has been investigated. Results of CARS measurements on a laboratory rocket-engine plume are also presented.

56001 (AD-A—050427) **Highly excited atoms. Final report 1 Apr 72—30 Sep 77.** Kleppner, D. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). 17 Nov 1977. Contract F44620-72-C-0057. 10p. NTIS PC A02/MF A01.

The major accomplishment under this contract was the innovation of techniques for the production and detection of highly excited atoms (Rydberg atoms), and a series of studies on the properties of Rydberg atoms in strong electric fields. Partly as a result of this work, the study of Rydberg systems has developed into an important new subfield of atomic physics during the past few years; already there have been two international meetings and several sessions at national meetings devoted to the subject. Much of the experimental work uses the combination of field ionization and atomic beams techniques developed under this contract. (Author)

56002 Lifetimes of the excited levels of Tm I and Tm II and oscillator strengths of Tm I spectral lines. Blagoev, K.B.; Komarovskii, V.A.; Penkin, N.P. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **44**: No. 2, 131-132(Feb 1978).

The lifetimes of twelve excited levels of Tm I and three levels of Tm II have been measured by the multichannel delayed coincidence method (DCM). Where possible, our results were compared with computed values and measurements published by other investigators, [E. Handrich et al., J. Phys. 30, Suppl. 1 (1969); P. Camus, J. Phys. 31, 985 (1970); R. Wallenstein, Z. Phys. 251, 57 (1972)]. The data obtained on the lifetimes of Tm I levels made it possible to calculate absolute values of coefficients for transitions for which we previously measured [V. A. Komarovskii and N. P. Penkin, Opt. Spectrosc. 26, 483 (1969), K. B. Balagoev et al., Opt. Spectrosc. 40, 356 (1976)] relative oscillator strengths of lines in the Tm I absorption spectrum. These lines start with the $4f^{13}6s^2v^2F^0$/sub 7/2,5/2/ levels.

56003 Cross sections for the photoionization of $H_2(X^1\Sigma$/sub g/+, v/sub i/=0-14) with the formation of $H_2^+(X^2\Sigma$/sub g/+, v/sub f/=0-18), and vibrational overlaps and R/sup n/-centroids for the associated vibrational transitions. Flannery, M.R.; Tai, H.; Albritton, D.L. (Joint Institute for Laboratory Astrophysics, University of Colorado). *At. Data Nucl. Data Tables;* **20**: No. 6, 563-585(Dec 1977).

Cross sections for the photoionization of $H_2(X^1\Sigma$/sub g/+), initially in vibrational levels v/sub i/=0-14, with the production of $H_2^+(X^2\Sigma$/sub g/+) in vibrational levels of v/sub f/=0-18 are tabulated for the full vibrational array at 24 photon wavelengths ranging from 912 A to 450 A. The associated vibrational overlap integrals <v/sub i/vertical-barv/sub f/> and R-centroids, <v/sub i/vertical-barR/sup n/vertical-barv/sub f/>/<v/sub i/vertical-barv/sub f/>, n=1 and 2 are also presented together with accurate curve fits of the bound-free (H_2-H_2^+ +e) electronic matrix elements.

56004 Effect of reduced mass in Stark broadening of hydrogen lines. Demura, A.V.; Lisitsa, V.S.; Sholin, G.V. (I. V. Kurchatov Institute of Atomic Energy). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 209-215(Aug 1977).

A theory is developed which describes the deformation of the Stark contour of hydrogen lines near the center, brought about by the thermal motion of the perturbing ions. The method of calculation is based on systematic perturbation theory with respect to the parameter Psi-dot/sub tau/<1, where Psi-dot is the characteristic rotation frequency of the ion field, while tau is the atom lifetime on the Stark sublevel and depends on the impact electron broadening w ~tau^{-1}. The main regularities of the "reduced mass effect" are explained, viz., the experimentally observed dependence of the spectral variation of the contour I ($\Delta\lambda$) near the center of the hydrogen line on the concentration of the plasma N and the reduced mass of the perturbing ions μ. The effect is of interest as a means of determining the ion temperature T/sub i/ and of investigating the ion microfield fluctuations in the plasma.

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

56005 Energies and widths of pionic-atom states and the distribution of nucleons in nuclei. Bunatyan, G.G.; Pol', Y.S. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 433-436(Oct 1977).

An analysis is made of the theoretical results and experimental data on the transition energies and widths of levels of pionic atoms. The dependence of these quantities on the features of the nuclear density distribution is studied. It is shown that it is necessary to take into account this dependence, although it does not lead to improvement of the detailed description of the experimental data.

56006 Mesic atoms of light nuclei in the field of resonant electromagnetic radiation. Batkin, I.S.; Smirnov, Y.G.; Churakova, T.A. (Voronezh State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 202-205(Aug 1977).

We consider the influence of resonant electromagnetic radiation on the characteristics of light mesic atoms (^{1}H, ^{2}H, ^{3}He, and ^{6}Li). The conditions are investigated under which the populations of the hfs sublevel populations become equalized in the case of linearly polarized radiation. We calculate the dependence of the critical external field (at which saturation is reached) on the collision and Doppler widths of the level. The degree of muon polarization produced when the mesic atom interacts with circularly polarized resonant radiation is determined. It is noted that the most strongly polarized is the muon in the mesic atoms of hydrogen isotopes. The effect of resonant electromagnetic radiation on the rate of nuclear fusion in the pdμ molecule is also considered. It is shown that the yield of the fusion-reaction channel can be changed by 20% as a result of this action.

COLLISION PHENOMENA

56007 (AD-A—049064) **Effect of molecular rotation on vibrational relaxation. Final report.** Rogovin, D.N.; Scully, M.O.; Hopf, F.A. (Arizona Univ., Tucson (USA). Optical Sciences Center). Aug 1977. Contract F29601-74-A-0023. 24p. NTIS PC A02/MF A01.

This final report studies the effect of molecular rotation on vibrational relaxation. A model for complicated vibrational collisions is developed. Changes in the molecular rotation are of significant importance in vibration collision processes and dominate deactivation processes at thermal velocities.

56008 (AD-A—050006) **Comparison of heavy ion-induced K-alpha x-ray satellite spectra from gases and solids.** Demarest, J.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). Dec 1977. 124p. (AFIT-CI—78-31). NTIS PC A06/MF A01.

Thesis.

A study of the effects of chemical environment on the K-alpha satellite spectra of Si, SiF_4, SiH_4, P_4, S_8, SF_6, SO_2, H_2S, NaCl, KCl (Cl), CCl_4, Cl_2, HCl, Ar and KCl (K) excited by 32.4-MeV oxygen ions has been performed. The average degree of L-shell ionization at the time of K-alpha x-ray emission (as reflected by the satellite relative intensities) is much higher for the light gases SiH_4, H_2S, and HCl than for the corresponding heavy gases, solids, and liquid. It was determined from their correlation with local valence electron density that the L-shell ionization states do not depend upon physical state but upon the availability of electrons from neighboring atoms. For atoms with electron-rich ligands, interatomic electron transfer dominates the fast rearrangement occurring prior to K-alpha x-ray emission. The comparison of K-alpha satellite energy shifts with the results of Hartree-Fock calculations provided further support for the above conclusions. A theoretical prediction of multiple ionization employing the binary encounter approximation was found to overestimate the observed degree of L-shell ionization, but considerably improved agreement was obtained by accounting for the increases in L-shell binding energy as L-shell electrons are removed.

56009 (AD-A—050380) **Theoretical and computational studies of electronic transitions in molecular collisions. Final technical report 15 May 74—14 Nov 77.** George, T.F. (Rochester Univ., NY (USA). Dept. of Chemistry). 13 Jan 1977. Contract F44620-74-C-0073. 15p. NTIS PC A02/MF A01.

Semiclassical and quantum mechanical methods were developed to describe energy transfer, and reaction dynamics in molecular collision systems. Emphasis was given to processes involving electronic transitions and the dynamic coupling of two or more potential energy surfaces. Calculations were carried out for reactive collisions of a proton with deuterium molecule and reactive collisions of fluorine atom in its excited spin-orbit state with hydrogen molecule. Calculations were also performed for nonreactive collisions of halogen atoms with hydrogen molecule, where resonance behavior in electronic-to-rotational energy transfer was observed for the case of fluorine atom, and likewise in electronic-to-vibrational energy transfer for the case of bromine atom. The semiclassical and quantum mechanical methods were extended to the study of molecular collision processes in the presence of intense laser radiation (power density greater than a megawatt per square centimeter). This study revealed that such radiation can have dramatic effects on the dynamics of energy transfer and chemical reactions.

56010 (AD-A—050456) **Low energy atomic collisions. Final report 1 Jul—30 Sep 77.** Neynaber, R.H. (IRT Corp., San Diego, CA (USA)). 15 Nov 1977. Contract F44620-74-C-0002. 13p. (IRT—8096-010). NTIS PC A02/MF A01.

Measurements were made using either crossed or merging molecular beams. For the chemi-ionization reactions the relative energy of the reactants was varied from 0.01 to 10 eV, whereas for some of the ion-molecule processes energies of several hundred electron volts were used. The reactants included ground-state and metastable He, Ne, and Ar and H, D, N+, O+, Na, Kr, CO, NO, H2+, D2+, and HeD+. Measurements of absolute and relative cross sections as well as energy distributions of product ions were obtained. Unique techniques that were developed for studying the above reactions are described. In addition, general observations are made of the dynamics, cross sections, branching ratios, etc., for these processes. The studies were made to gain a better understanding of the dynamics of low energy atomic collisions and to attempt to define the role played by the kinetic and internal energy of reactants. Another goal of the program was to provide data to assist in the formulation of theory.

56011 **Semiclassical perturbation scattering theory: comparison of vibrational excitation of CO and N_2 by Li^+.** Hickman, A.P.; Smith, F.T. (Stanford Research Inst., Menlo Park, Calif. (USA)); Miller, W.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). pp 772-773 of International conference on the physics of electronic and atomic collisions. Vol. 2. Amsterdam; North-Holland (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

56012 **Charge transfer of C^+, N^+, and O^+ in N_2 and H_2.** Lockwood, G.J.; Miller, G.H.; Hoffman, J.M. (Beam Source Application Division 5232, Sandia Laboratories, Albuquerque, New Mexico 87185). *Phys. Rev., A;* **18**: No. 3, 935-939(Sep 1978).

We report absolute measurements of the total cross section σ_{10} for charge transfer of C^+, N^+, and O^+ in N_2 and H_2 in the energy range of 5—100 keV. Maxima in all six cross sections occur in this energy range.

56013 **Double-K-vacancy sharing in near-symmetric collisions.** Richard, P.; Hall, J.M.; Schmiedekamp, C.; Jamison, K.A. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). *Phys. Rev., A;* **18**: No. 3, 940-944(Sep 1978).

Double-K-vacancy sharing has been investigated for 30-MeV Cl on thick Ca, Sc, and Ti targets by measuring the ratios of the hypersatellite to the satellite K-x-ray yields in both collision partners. A simple extension of the single-K-vacancy-sharing model predicts a double-K-vacancy-sharing ratio equal to the square of the single-K-vacancy-sharing ratio. Our results are in agreement with this prediction.

56014 **K- and L-shell ionization of atoms by relativistic electrons.** Scofield, J.H. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., A;* **18**: No. 3, 963-970(Sep 1978).

Results of a relativistic calculation of the cross section for the ionization from the K and L shells by high-energy electrons are presented. The calculation use the first-order Born approximation to treat the interaction between the scattered and atomic electrons. Plane waves are used to treat the high-energy scattered electron, while solutions of the Dirac equation in a Hartree-Slater central potential are used to describe the atomic electrons. Results are presented for a set of elements from $Z = 18$ to 92 and incident energies from 50 keV to 1 GeV. Calculated results are given for the correction due to the density effect arising from the polarizability of the medium. In the calculation of this correction, the medium is treated as composed of free electons.

56015 **Variational treatment of electron degradation and yields of initial molecular species.** Rau, A.R.P.; Inokuti, M.; Douthat, D.A. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). *Phys. Rev., A;* **18**: No. 3, 971-988(Sep 1978).

We present a general theory of electron degradation and of the yields of initial species such as ions and excited states that appear in matter as a result of irradiation with electrons. We give variational expressions for observable quantities such as the degradation spectrum, the mean yields, and the yield fluctuations. A systematic analysis using variational principles reveals, in greater detail than ever before, relations among major analytical methods including the Fowler method, the Spencer-Fano method, and the method of Knipp et al. Each of these methods represents a different angle of approach to the same problem and leads to the same prediction for the mean yield of any initial species, for a fixed set of electron cross-section data. Among our findings it is noteworthy that the knowledge of the Spencer-Fano degradation spectra for various source-electron energies enables one to calculate by quadrature not only the mean but also the statistical fluctuations of the yield of any initial species. Furthermore, when one introduces small changes in the cross-section data (because of new information or upon consideration of chemical impurities in the medium), one may express the ensuing modifications of any observable quantity in the form of a perturbation expansion. Then, every term in the perturbation series is calculable again from the Spencer-Fano degradation spectra for various source energies for the unperturbed problem. In this respect and many others, the Spencer-Fano degradation spectrum is the most basic element in the solution of the degradation problem. Finally, our mathematical analysis of various difference-integral equations (including nonlinear equations) may be of interest in areas other than electron degradation. Therefore, the present paper includes remarks on the physical meaning of adjoint operators and on other points belonging to general mathematical physics.

56016 **Calculation of radiative single-charge-transfer cross sections for collisions of He^{2+} with He at low energy.** Cohen, J.S.; Bardsley, J.N. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., A;* **18**: No. 3, 1004-1008(Sep 1978).

A theoretical study of low-energy collisions of He^{2+} with He has been made. Potential curves are obtained using generalized valence-bond wave functions for the X $^1\Sigma^+$/sub g/ state formed from $He^+ + He^+$ and the B $^1\Sigma^+$/sub u/ and E $^1\Sigma^+$/sub g/ states formed from $He^{2+} + He$. The predominant mechanism for single charge transfer is a radiative transition. The dipole transition moment connecting the B and X states is calculated using the ab initio wave functions. The radiative collision problem is formulated in terms of a complex potential and solved in the JWKB approximation. Cross sections are presented for energies from 0.001 to 10 eV. A rate constant of 3.6×10^{-14} cm^3/sec at 300 K is obtained. This value is in satisfactory agreement with the recent experimental result and there is some evidence that the remaining discrepancy is due to the effect of tunneling and shape resonances, which have been estimated to increase the rate to 4.4×10^{-14} cm^3/sec. The splitting of the asymptotically degenerate B $^1\Sigma^+$/sub u/ and E $^1\Sigma^+$/sub g/ states is also examined and a conflict with a recent prediction of the asymptotic splitting is resolved.

56017 **Mobility of α particles in helium.** Wadehra, J.M.; Cohen, J.S.; Bardsley, J.N. (Theoretical Division, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Phys. Rev., A;* **18**: No. 3, 1009-1011(Sep 1978).

The mobility of α particles in helium gas is calculated using the zeroth-order Viehland-Mason theory with interaction potentials recently computed by Cohen and Bardsley. The results show a dependence on field strength similar to the measurements of Johnsen and Biondi but are lower in magnitude by about 5%.

56018 **Threshold behavior of the cross sections for scattering of electrons by polar molecules.** Fabrikant, I.I. (Institute of Physics, Academy of Sciences of the Latvian SSR). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 693-697(Oct 1977).

The behavior of the cross sections for elastic and inelastic scattering of electrons by polar molecules near the threshold of the inelastic process is considered for the energy range in which a decisive role is played by the electron-dipole interaction. The possibilities of observing resonances and threshold anomalies in the cross sections are discussed. Some experimental data are interpreted in the light of the results.

56019 **Exchange excitation of an atom by electrons with high angular momenta.** Demkov, Y.N.; Ostrovskii, V.N. (Leningrad State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 3, 449-451(Sep 1977).

A parameter is found which governs the exponential decrease at large angular momenta of the partial amplitudes for exchange scattering of an electron on an atom (in general with excitation of the atom). This decrease becomes slower as the energy of the collision increases. The contribution of these partial amplitudes to the differential cross section has a peak for forward scattering. The effective parameters which describe this peak are discussed, and we also consider the dependence of the shape of the peak on the properties of the wave functions of the initial and final states of the atom.

56020 **Vibrational excitation of molecules during resonance scattering of electrons.** Golubkov, G.V.; Dalidchik, F.I.; Ivanov, G.K. (Institute of Chemical Physics, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 230-235(Aug 1977).

An analytic solution is obtained within the framework of the displaced oscillator model for the vibrational transitions of molecules during resonance scattering of electrons. Limiting and special cases illustrating the properties of the excitation functions under different physically possible conditions are examined. More precise conditions are established for the validity of existing approximations (intermediate compound state and pulsed resonance scattering). Expressions

are obtained for the vibrational transitions when these conditions are violated. Vibrational transitions during electron scattering by excited molecules are discussed. Resonance dissociation of diatomic molecules is investigated and, in particular, it is noted that the intermediate autoionization complex can be investigated by examining the spectrum of dissociation products. The model is generalized to the multidimensional case, and this is then used to investigate analytically the vibrational transitions in polyatomic molecules. The theory is illustrated by the example of vibrational excitation of molecular nitrogen, and the results obtained are in good agreement with experiment.

56021 Formation of excited fragments in the dissociation of halogenated methane compounds by electron impact. Danilevskii, N.P.; Koppe, V.T.; Koval', A.G.; Khovanskii, N.A. (Khar'kov State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 236-237(Aug 1977).

We measured the effective cross sections for the dissociation of halogenated methane compounds into excited fragments. The dependence of the cross section σ for the formation of the fragment CH^* ($A^2\Delta$) on the binding energy E/sub b/ of this radical in the investigated molecule is obtained in the form $\sigma = A \exp(-kE/\text{sub b/})$, where $A = (8 +- 1) \times 10^{-17}$ cm^2 and $k = 0.6 +- 0.07$ eV^{-1}.

56022 Cross section of excitation of molecular vibrational levels by electron impact. Smirnov, B.M.; Firsov, O.B. (I. V. Kurchatov Institute of Atomic Energy). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 238-242(Aug 1977).

The Breit-Wigner formula for the cross section for the excitation of a molecule by electron impact via formation of an intermediate autoionization state of a negative ion is generalized to include the case when the width of the autoionization level is small in comparison with the vibrational quantum of the negative ion. Use is made of the absence of transitions between vibrational levels of a negative ion during its lifetime, and also of the physical conditions for the formation and decay of the ion. For the case when the width of the autoionization level is independent of the nuclear configurations of the negative ion, an expression is obtained for the cross section of the transition between the vibrational levels of the negative ion at an arbitrary ratio of the level width to the vibrational quantum of the ion.

56023 Feasibility of investigating atomic collisions by the photon-echo technique. Alekseev, A.L.; Evseev, I.V.; Ermachenko, V.M. (Moscow Engineering Physics Institute). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 246-251(Aug 1977).

An integral of elastic depolarizing collisions is obtained with account taken of the dependence of the velocity vector on the velocity of the exciting atom. The calculations are valid for any collision model involving a short-range interaction potential between two atoms, one of which is in the excited state and the other in the ground state. The result is presented in a form which is convenient in spectroscopy problems. Graphs of the dependence of the relaxation parameters on the modulus of the velocity of the exciting atom are given for quasiresonant collisions. The feasibility of determining experimentally the parameters characterizing elastic atomic collisions by investigating the photon echo is demonstrated for the case of resonant atomic transitions with change of the total angular momentum Iarrow-right-left0. The information obtained in this manner is much more complete than that obtained by the existing experimental methods.

56024 Total cross sections for collisions between atomic particles at high relative speeds. Inokuti, M. (Argonne National Lab., Ill. (USA)). pp 280-281 of International conference on the physics of electronic and atomic collisions. Vol. 1. Amsterdam; North-Holland (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

56025 Impact-parameter dependent inner-shell vacancy production in 0.7 to 2.7 MeV/amu $^{58}_{28}$Ni collisions with $_{25}$Mn, $_{50}$Sn, and $_{82}$Pb. Johnson, B.M.; Jones, K.W.; Brandt, W. (Brookhaven National Lab., Upton, N.Y. (USA)); Jundt, F.C.; Guillaume, G. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires); Kruse, T.H. (Rutgers--the State Univ., New Brunswick, N.J. (USA)). pp 326-327 of International conference on the physics of electronic and atomic collisions. Vol. 1. Amsterdam; North-Holland (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

56026 Threshold behavior for collision-induced dissociation. Parks, E.K.; Sheen, S.H.; Dimoplon, G.; Wexler, S. (Argonne National Lab., IL). *ACS Symp. Ser.;* No. 56, 94-99(1977).

A fundamental collisional process at elevated energies is the dissociation of a molecule into two or more fragments via a collision with a third body. This so called collision-induced dissociation (CID) has been observed extensively in ion-molecule reactions and, in more recent years, between neutral species. CID of the alkali and thallium halides to ion pairs has been studied for the last few years, and the threshold behavior for the process has been determined. Typical reactions observed are $M + CsCl \rightarrow M + Cs^+ + Cl^- \rightarrow CsM^+ + Cl^-$ for the monomer, and $M + Cs_2Cl_3 \rightarrow M + Cs_2Cl^+ + Cl^- \rightarrow M + Cs^+ + CsCl_2^-$ for the dimer.

ATOMIC AND MOLECULAR THEORY

56027 Possibility of studying the structure of weak neutral currents in optical transitions in heavy atoms. Novikov, V.N.; Sushkov, O.P.; Flambaum, V.V.; Khriplovich, I.B. (Institute of Nuclear Physics, Siberian Division, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 3, 420-422(Sep 1977).

Effects of parity nonconservation, caused by the weak interaction of neutral electronic vector and nucleonic axial currents, are examined in optical transitions in thallium, lead, bismuth, and cesium. Degrees of circular polarization of the light are calculated for ordinary and strongly forbidden M1 transitions.

56028 Molecular excitons in small aggregates. Kasha, M. (Florida State Univ., Tallahassee). pp 337-363 of Spectroscopy of the excited state. DiBartolo, B. (ed.). New York; Plenum Publishing Corp. (1976).

The molecular exciton model, which deals with the excited state resonance interaction in weakly coupled electronic systems, is described as an interpretative tool for the study of the spectra and photochemistry of composite molecules. Under composite molecules are grouped loosely bound groups of light-absorbing units, held together by hydrogen bonds or by van der Waals forces. Another group of composite molecules included in the study consists of covalently bound light-absorbing units. A skeletal outline of the simplest quantum mechanical framework for the description of the model is presented. Dimers of various geometries, cyclical higher aggregates, linear chain polymers, helical polymers, and molecular lamellar arrays are reviewed. The exciton splitting diagrams and electric dipole selection rules are discussed quantum mechanically and by means of a transition dipole vector model. Applications to absorption and luminescence spectroscopy of molecular aggregates are cited. Photochemical sensitization and photobiological applications are suggested, and areas of new research are enumerated.

56029 Polarization of zero-field transitions of the lowest triplet state of benzophenone. Gossett, E.W.; El-Sayed, M.A. (Univ. of California, Los Angeles). *Chem. Phys. Lett.;* **32**: No. 1, 51-55(1 Apr 1975).

The polarization characteristics of the zero-field (zf) transitions of benzophenone in bis(4-bromophenyl) ether are examined at 1.6°K using optical detection. The results indicate that the transitions are mostly magnetic dipole in nature and that the size of the electric dipole transition moment resulting from spin—orbit perturbation is less than 10^{-4} debye. This is being blamed on the small moment of the n, π reversible π, π^* triplet—triplet transition that could provide electric allowance in these magnetic transitions. Anomalous magnetic dipole results are obtained on the ab face that can be explained by mixing with host crystal states.

GENERAL FLUID DYNAMICS

56030 (ORNL/TM—6448) Hydrodynamics of three-phase fluidized beds. Begovich, J.M. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 305p. Dep. NTIS, PC A14/MF A01.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The hydrodynamics of three-phase (gas-liquid-solid) fluidized beds has been studied in two columns with inside diameters of 7.62 and 15.2 cm respectively. The minimum gas and liquid velocities necessary to fluidize various types of solids were determined and correlated as a function of the particle size and density and the liquid viscosity; no effect of the initial bed height or column diameter was found. Overall phase holdups, or volume fractions, determined from a homogeneous bed model were combined with similar literature data to yield correlations for the overall gas and solid phase holdups. The overall gas holdup increased as the gas velocity was increased, while the overall solid holdup was decreased by increased liquid velocity and was increased by increased particle diameter or solid/liquid density difference. An electroconductivity technique was developed for use in the three-phase fluidized beds which allowed each of the phase holdups to be determined at any point in the column. The technique has shown the existence of a transition region as the bed goes from a three-phase to a two-phase system. The holdup profiles were fitted using the error function, and the mean and standard deviation of the solid holdup profile, along with the gas and solid holdups in the regions where they were constant, were meas-

ured for each set of run conditions. Use of these five parameters, which were correlated with the physical pxrameters of the systems studied, permits each of the three phase holdup profiles to be predicted. This gives the reactor designer more information concerning phase distributions than was available previously; thus it will aid in the design of reactors where local conditions throughout the bed must be considered.

56031 (SAND—78-8245) **Computational nature of combustion modeling.** Kee, R.J. (Sandia Labs., Livermore, CA (USA)). Jul 1978. Contract EY-76-C-04-0789. 52p. Dep. NTIS, PC A04/MF A01.

An overview is given which describes the role of computational modeling in combustion research. The modeling effort is divided into two broad subgroups-fundamental processes and systems simulation-which are amenable to computational solution. The study of fundamental processes is addressed primarily at understanding complex chemical kinetic interactions while systems simulation seeks primarily to quantify complicated hydrodynamic behavior. Even though the two approaches seek to predict different aspects of combustion phenomena, they share a number of common computational difficulties. Four such areas are identified and the scope of the mathematical problems are outlined. These topics are operator-splitting, stiff differential equations, coordinate systems and resolution and iterative minimization techniques.

56032 Initial value problem for Rayleigh—Taylor instability of viscous fluids. Menikoff, R.; Mjolsness, R.C.; Sharp, D.H.; Zemach, C.; Doyle, B.J. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **21**: No. 10, 1674-1687(Oct 1978).

The initial value problem associated with the development of small amplitude disturbances in Rayleigh—Taylor unstable, viscous, incompressible fluids is studied. Solutions to the linearized equations of motion which satisfy general initial conditions are obtained in terms of Fourier—Laplace transforms of the hydrodynamic variables, without restriction on the density or viscosity of either fluid. When the two fluids have equal kinematic viscosities, these transforms can be inverted explicitly to express the fluid variables as integrals of Green's functions multiplied by initial data. In addition to normal modes, a set of continuum modes, not treated explicitly in the literature, makes an important contribution to the development of the fluid motion.

56033 Anharmonic analysis of a time-dependent packed bed thermocline. Margolis, S.B. (Applied Mathematics Division 8322, Sandia Laboratories). *Q. Appl. Math.;* **37**: No. 3, 97-114(Jul 1978).

A vectorized separation of variables approach is applied to a coupled pair of parabolic partial differential equations describing the degradation of a thermocline in a packed bed thermal storage tank. The time-dependent quasi-one-dimensional model includes the effects of finite tank length, thermal conduction in the direction parallel to the tank walls, and heat transfer between the fluid and solid components of the bed. For certain classes of boundary conditions, the analysis leads to an eigenvalue problem for the spatial dependence of the fluid and solid temperatures in the bed. The eignevalues and corresponding eigenfunctions are readily calculated, and completeness of the eigenfunctions follows from a transformation to an integral equation by the construction of a Green's tensor function. The method is illustrated by an example which arises in the analysis of the thermal storage subsystem of a central solar receiver power plant.

56034 Convergence of vortex methods for Euler's equations. Hald, O.; Del Prete, V.M. *Math. Comput.;* **32**: No. 1143, 791-809(Jul 1978).

A numerical method for approximating the flow of a two dimensional incompressible, inviscid fluid is examined. It is proved that for a short time interval Chorin's vortex method converges superlinearly toward the solution of Euler's equations, which govern the flow. The length of the time interval depends upon the smoothness of the flow and of the particular cutoff. The theory is supported by numerical experiments. These suggest that the vortex method may even be a second order method.

MAGNETOHYDRODYNAMICS

56035 Two-dimensional magnetohydrodynamic calculations of the plasma focus. Maxon, S.; Eddleman, J. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Fluids;* **21**: No. 10, 1856-1865(Oct 1978).

Two-dimensional magnetohydrodynamic calculations on plasma focus experiments in the Mather geometry are described. The properties of the two-dimensional numerical solutions are discussed. Detailed results are given for a specific problem which compares favorably with experiment. The numerical solution for the plasma focus previously given by Potter has been rerun with substantial disagreement. Arguments are given to show that the Potter code is incorrect.

SUPERFLUIDITY

56036 (AD-A—049157) **Non-linear parametric generation of sound by resonant mode conversion. Interim technical report.** Garrett, S.L. (California Univ., Los Angeles (USA). Dept. of Physics). Dec 1977. Contract N00014-75-C-0246. 187p. NTIS PC A09/MF A01.

When non-linear terms are included in the two-fluid hydrodynamic description of superfluid helium-4, first sound and second sound are coupled. The interaction of two second sound waves to produce a propagating first sound wave is shown to occur at a specific angle which makes the point of intersection of the second sound waves travel at the speed of first sound. An experiment to observe this mode-conversion process in a waveguide of rectangular cross-section is described. Measurements show that the resonant conversion occurs at the theoretically predicted frequency. The amplitude of the mode-converted first sound is found to exhibit a quadratic dependence on the amplitude of the primary wave which is characteristic of a second-order effect. A new application of the reciprocity calibration technique allowed an absolute calibration of the pressure microphones in situ. Absolute measurements of the coupling of first sound to second sound agree with theory. This agreement is a direct confirmation of the importance of the additional, intrinsically non-linear, Galilean invariant variable in the thermohydrodynamics of superfluid helium. The theoretical formalism is applied to the parametric amplification of second sound by high-intensity first sound, and the results are in disagreement with a previous calculation by Khokhlov and Pushkina.

56037 (NTIS/PS—78/0242) **Superfluidity (a bibliography with abstracts). Report for 1964—Feb 78.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 162p.

The cited reports discuss superfluidity in liquid helium, with both helium 3 and helium 4 considered. Topics discussed include phase studies, heat transfer, hydrodynamics, rotons, zero sound, first sound, second sound, third sound, and fourth sound. (This updated bibliography contains 157 abstracts, 1 of which is a new entry to the previous edition.)

56038 Functional for the hydrodynamic action and the Bose spectrum of superfluid Fermi systems of the He^3 type. Alonso, V.; Popov, V.N. (Leningrad Division of the Steklov Mathematics Institute, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 760-767(Oct 1977).

A hydrodynamic-action functional is constructed by a continual-integration method for Fermi systems with pairing in the p state. A simplified model is considered in which it is possible to introduce local fields that describe tensor Bose condensates. It is shown that the most stable is the B phase, which undergoes a second-order phase transition into a planar 2D phase in a sufficiently strong magnetic field. The A phase is metastable in the considered model and is destroyed by an arbitrarily weak magnetic field. The Bose spectrum of the system is investigated. In the model in question it contains four phonon branches in the B phase, six in the 2D phase, and nine in the A phase. In the more general case of a type-He^3 Fermi system there are four branches each in the B and 2D phases and five in the A phase. Qualitative conclusions are deduced for real superfluid He^3. In particular, arguments are advanced favoring a second-order phase transition from the B phase to a planar 2D phase in a sufficiently strong magnetic field.

56039 Lagrange and Hamilton equations of hydrodynamics for anisotropic superfluid He^3-A liquid. Lebedev, V.V.; Khalatnikov, I.M. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 808-813(Oct 1977).

The Lagrangian method of obtaining the equations of hydrodynamics for He II is generalized to the case of the quantum anisotropic liquid He^3-A. A complete set of He^3-A orbital hydrodynamic equations is derived on the basis of the Lagrange equations. It is shown how the set of Lagrange equations can be reduced to the Hamilton form. The spin subsystem parameters are included in the Hamiltonian formalism The He^3-A spin equations of hydrodynamics are found by taking into account the presence of an external magnetic field. The general form of the conservation laws for a system obeying the Hamilton equations is presented. The energy, momentum, angular momentum and total spin conservation laws are found on this basis. The form of the dissipative corrections to the He^3-A equations of hydrodynamics is considered. The kinetic coefficients are enumerated and the requirements are found which they should satisfy in the case of a combined analysis of the spin and orbital subsystems as well as in the case of an analysis of only the latter subsystem.

56040 Absorption of sound in helium II. Matveev, Y.A. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 3, 498-502(Sep 1977).

A theory is developed describing the propagation of high-frequency sound in helium II at low temperatures (T<0.6 K) and high pressures (P>16 atm), when the energy spectrum of the phonons becomes stable. The absorption coefficient and the sound dispersion are calculated under these conditions. The dependence of the velocity of second sound on the frequency is determined. The resonance properties of the obtained solution are discussed.

56041 Particle-like solitons in superfluid ^{3}He phases. Volovik, G.E.; Mineev, V.P. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 401-404(Aug 1977).

All the types of particle-like solitons possible in the A and B phases of ^{3}He are considered with allowance for the spin-orbit interaction. These solitons do not have singularities anywhere in the field of the order parameter, and are characterized by a topological invariant and a finite dimension and energy. Asymptotic solutions of the Ginzburg-Landau equation at large distances from the soliton and at the soliton center are found. It is shown that there exists in the A phase a type of soliton possessing a momentum that stabilizes the soliton size. Like ring vortices, solitons of this type effect the transfer of momentum from the superfluid component of the liquid to the normal component.

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

56042 Measurement of the threshold behavior of $\pi^+\pi^-$ production in e^+e^- annihilation. Bacino, W.; Ferguson, T.; Nodulman, L.; Slater, W.; Ticho, H.K.; Diamant-Berger, A.; Faessler, M.; Hall, A.; Irwin, G.; Kirkby, J.; Merritt, F.; Wojcicki, S.; Burns, R.; Condon, P.; Cowell, P.; Kirz, J. (University of California, Los Angeles, California 90024). *Phys. Rev. Lett.;* **41**: No. 1, 13-15(3 Jul 1978).

We have observed 692 events of the type $e^+e^- \rightarrow e^{+-}X^{-+}$ (X not = e) in the center-of-mass energy range 3.1 GeV < E/sub c.m./ < 7.4 GeV. The observation of events below D^0D-bar^0 threshold clearly precludes their association with charm. The data are well fitted by a pointlike spin-1/2tau lepton with mass 1782^{+2}/sub -/7 MeV, electronic branching ratio 0.160 +- 0.013, and branching ratio to > or = 3 charged particles 0.32 +- 0.05.

56043 Measurement of the asymmetry in photoproduction of π^0 mesons in the resonance region. Avakyan, R.O.; Avakyan, E.O.; Avetisyan, A.E.; Armaganyan, A.A.; Akopov, N.Z.; Bakhshetsyan, R.A.; Vartapetyan, G.A.; Danagulyan, S.S.; Iskandaryan, A.G.; Kosakov, I.K.; Mirzoyan, R.M.; Oganesyan, A.A.; Oganesyan, M.A.; Petrosyan, Z.V.; Sarkisyan, R.T.; Skhtoryan, E.M.; Taroyan, S.P.; Elbakyan, G.M. (Erevan Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 537-538(Nov 1977).

The asymmetry of the cross section has been measured in photoproduction of π^0 mesons by polarized photons in the energy interval E/sub γ/=0.8—1.3 GeV at a c.m.s. angle θ^*/sub gammapi/ =60°. The measurements indicate existence of a peak in the asymmetry for an angle θ^*/sub gammapi/=60° in the angular distribution of the asymmetry.

56044 Angular dependence of the parameters B and C of the normalized invariant cross section rho=C exp(—Bp^2) of the reaction γ +A→p+A′ for a bremsstrahlung maximum energy 4.5 GeV. Alanakyan, K.V.; Amaryan, M.D.; Demirchyan, R.A.; Egiyan, K.S.; Ogandzhanyan, M.S.; Sharabyan, Y.G. (Erevan Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 539-541(Nov 1977).

New experimental data are presented on nuclear scaling in the inclusive reaction γ+A→p+A′ for (E/sub γ/)/sub max/=4.5 GeV in the nuclei ^{12}C, ^{63}Cu and ^{208}Pb. The angular dependences of the parameters of the exponential representation of the normalized invariant cross section rho= (1/σ/sub tot/) f =C exp(—Bp^2), which have not been available up to the present time, have been obtained and the possibilities are discussed of comparing the experimental results with results of theoretical attempts to explain the production of cumulative particles.

WEAK INTERACTIONS

56045 Inclusive neutral-strange-particle production from high-energy νp charged-current interactions. Berge, J.P.; Bogert, D.; Cundy, D.C.; DiBianca, F.A.; Endorf, J.; Hanft, R.; Kochowski, C.; Malko, J.A.; Moffatt, G.; Nezrick, F.A.; Scott, W.G.; Smart, W.; Lynch, G.R.; Marriner, J.P.; Stevenson, M.L.; Cence, R.J.; Harris, F.A.; Jones, M.; Parker, S.I.; Peters, M.W.; Peterson, V.Z.; Stenger, V.J.; Bell, J.; Coffin, C.T.; Diamond, R.N.; French, H.T.; Louis, W.C.; Roe, B.P.; Ross, R.T.; Seidl, A.A.; Vander Velde, J.C.; Wang, E. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **18**: No. 5, 1359-1366(1 Sep 1978).

We have studied the properties of inclusive neutral-strange-particle production in charged-current νp interactions. The rate for producing at least one neutral strange particle in a charged-current interaction is 0.14 +- 0.02. The inclusive distributions for events with neutral strange particles and for all charged-current events exhibit the same qaulitative behavior. We find no acceptable candidates for the $\Delta S = -\Delta Q$ Λ production reaction $\nu p \rightarrow \mu^- 2\pi^+ \pi^-$ in approximately 3000 charged-current events with E/sub ν/ > 10 GeV. We find upper limits (relative to the total charged-current sample) for charmed-particle production in any one mass region with subsequent decay into $\Lambda m\pi$ and $Km\pi$ final states of 1% and 2%, respectively.

56046 Probing nuclei with antineutrinos. Berge, J.P.; Bogert, D.; Endorf, R.; Hanft, R.; Malko, J.A.; Moffatt, G.; Nezrick, F.A.; Scott, W.G.; Smart, W.; Wolfson, J.; Ammosov, V.V.; Denisov, A.G.; Ermolov, P.F.; Gapienko, V.A.; Klyukhin, V.I.; Koreshev, V.I.; Mukhin, A.I.; Pitukhin, P.V.; Rjabov, Y.G.; Slobodyuk, E.A.; Sirotenko, V.I.; Efremenko, V.I.; Gorichev, P.A.; Kaftanov, V.S.; Khovansky, V.D.; Kliger, G.K.; Kolganov, V.Z.; Krutchinin, S.P.; Kubantsev, M.A.; Rosanov, A.N.; Savitsky, M.M.; Shevchenko, V.G.; Bell, J.; Coffin, C.T.; French, H.T.; Louis, W.C.; Roe, B.P.; Ross, R.T.; Seidl, A.A.; Sinclair, D. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **18**: No. 5, 1367-1369(1 Sep 1978).

From a sample of charged-current antineutrino events in a Ne-H mixture we have obtained a subsample of events having a backward proton in the laboratory. The systematics of these backward-proton events are found to be in agreement with previous results from backward-proton events obtained using hadron and γ beams.

56047 Combined analysis of K°/sub e/3 and K°/sub mu3/ decays. Dzhordzhadze, V.P.; Kekelidze, V.D.; Krivokhizhin, V.G.; Kukhtin, V.V.; Likhachev, M.F.; Savin, I.A.; Sil'vestrov, L.V.; Takhtamyshev, G.G. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 478-479(Oct 1977).

The form factors for K°/sub e/3 and K°/sub mu3/ decays are determined in a combined analysis based on 47,000 K°/sub e/3 decays and 82,000 K°/sub mu3/ decays.

STRONG BARYON-INDUCED INTERACTIONS

56048 Comparison of high-p/sub T/ events produced by pions and protons. Corcoran, M.D.; Cormell, L.; Cortez, C.; Dris, M.; Erwin, A.R.; Gollon, P.J.; Harvey, E.H.; Kanofsky, A.; Kononenko, W.; Lazo, G.; Loveless, R.J.; O'Neill, E.M.; Robinson, B.; Selove, W.; Thompson, M.; Yost, B. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev. Lett.;* **41**: No. 1, 9-12(3 Jul 1978).

We have measured high-p/sub T/ π^0's and jets with a two-arm calorimeter detector. Pions produce large-x/sub T/ jets more readily than do protons. We report the first direct measurement of two-arm jets. We find that the jet pairs have roughly balanced p/sub T/ and that pions produce jet pairs at more forward angles than do protons. These results give evidence for a constituent-scattering model, with constituents of higher average momentum in the pion.

56049 Pion production in nuclei by 660-MeV protons. Batusov, Y.A.; Grishashvili, I.F.; Dzhalaganiya, D.D.; Kostanashvili, N.I.; Lebedevich, G.I. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 511-513(Nov 1977).

Nuclear emulsions have been used to obtain the energy spectra of pions produced at an angle of 105° in the nuclei C, Al, Cu, and Pb by 660-MeV protons. The relative cross sections for production of slow pions in various nuclei have been compared with calculations taking into account their Coulomb and nuclear interactions inside the parent nuclei. The dependence of the cross sections on atomic number have been determined for various pion energies.

56050 Study of the mechanism of nucleon excitation in proton-neutron collisions at 19.2 GeV/c. Boos, E.G.; Mosienko, A.M.; Tursunov, R.A. (Institute of High-Energy Physics, Kazakh Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 430-433(Oct 1977).

Exclusive proton-neutron interactions are discussed on the basis of an analysis of 7600 three-prong events recorded in the CERN 200-cm deuterium bubble chamber. Study of the experimental distributions in M/sub eff/ and of the corresponding diagrams permits information to be obtained on diffraction excitation of nucleons and permits the diffraction dissociation cross sections to be determined for two-particle and three-particle decay modes.

STRONG MESON-INDUCED INTERACTIONS

56051 Backward resonance production in $\pi^- p \rightarrow n\pi^+\pi^-$ at 8 GeV/c. Eisenstein, B.; Elliott, J.; Mollet, W.; Nelson, B.; Rhines, D.S.; Wagner, R.G.; Wroblicka, W.T.; Watson, J.; Gelfand, N.M.; Morris, G.R. (University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Phys. Rev., D;* **18**: No. 5, 1370-1381(1 Sep 1978).

We have studied backward meson and baryon production in $\pi^- p \rightarrow n\pi^+\pi^-$ at 8 GeV/c using a streamer chamber triggered by the detection of the interaction of theneutron in thick-plate optical spark chambers. Our data sample of 866 events is dominated by the quasi-two-body final states $\Delta^-(1232)\ \pi^+$, nrho^0, and nf^0. We study the differential and total backward cross sections for these states and the decay angular distributions of the resonances. The results for the Δ^- and rho^0 indicate that both nucleon and Δ exchange inthe u channel are important in their production, while f^0 production is, as expected, consistent with nucleon exchange.

56052 Analysis of dispersions of particle distributions in rapidity in $\pi^- p$ interactions at 40 GeV/c. Baatar, T.; Ivanovskaya, I.A.; Kanarek, T.; Togoo, R.; Chadraa, B. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 541-544(Nov 1977).

We have investigated the distributions in longitudinal rapidity, the dispersions of these distributions, and their dependence on the multiplicity of charged particles produced in $\pi^- p$ interactions at 40 GeV/c. The experimental results have been compared with the predictions of the multiperipheral cluster model. It is shown that the dependence of the dispersion on the charged-particle multiplicity is not satisfactorily described by the selected variant of the model, which satisfactorily describe all the experimental distributions considered up to this time.

56053 Two-particle correlations in inclusive pion-carbon interactions at 40 GeV/c. Angelov, N.; Backovic, S.; Grishin, V.G.; Dzhmukhadze, S.V.; Didenko, L.A.; Ivanovskaya, I.A.; Inogamova, T.Y.; Kanarek, T.; Kladnitskaya, E.N.; Kozlovskaya, S.S.; Lyubimov, V.B.; Lyutov, S.I.; Melnikova, N.N.; Nagy, Y.; Nazargulov, R.M.; Nikitina, V.F.; Popova, V.M.; Solomin, A.N.; Semerdzhiev, K.I.; Solov'ev, M.I.; Suleimanov, M.; Tuvdendorzh, D.; Fadeev, N.G.; Tsivtsivadze, E.T.; Shcheglova, L.M. *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 545-547(Nov 1977).

We have studied correlations in rapidity and distributions in the difference of azimuthal angles of π mesons produced in $\pi^- C$ interactions at p/sub π/-=40 GeV/c. The data on azimuthal correlations were obtained with different restrictions on rapidity and transverse momenta of the π mesons. A comparison is made with the results for $\pi^- p$ interactions at the same primary π^--meson energy. The shape of the correlation functions for $\pi^- C$ events turns out to be close to the corresponding distributions for $\pi^- p$ interactions, and the correlations themselves in collisions with nuclei are somewhat weaker than in pion-nucleon collisions.

56054 Distributions in multiplicity of secondary charged particles in $\pi^{-12}C$ interactions at p=40 GeV/c. Backovic, S.; Grishin, V.G.; Nagy, Y.; Shabel'skii, Y.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 547-549(Nov 1977).

The Glauber model with inclusion of inelastic screening by diffraction beams of low mass has been used to calculate the multiplicities of secondary charged particles in $\pi^{-12}C$ interactions at p =40 GeV/c. Good agreement with the experimental data is obtained.

56055 Identical-particle interference in $\pi^- p$ interactions at 40 GeV/c. Angelov, N.; Backovic, S.; Grishin, V.G.; Dzhmukhadze, S.V.; Didenko, L.A.; Ivanovskaya, I.A.; Inogamova, T.Y.; Kanarek, T.; Kladnitskaya, E.N.; Lyubimov, V.B.; Mel'nikova, N.N.; Nady, Y.; Nazargulov, R.M.; Nikitina, V.F.; Popova, V.M.; Solomin, A.N.; Semerdzhiev, K.; Solov'ev, M.I.; Suleimanov, M.K.; Tuvdendorzh, D.; Tsivtsivadze, E.T.; Scheglova, L.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 419-422(Oct 1977).

Interference of identical π mesons produced in $\pi^- p$ interactions at 40 GeV/c is shown to exist. The method proposed by Kopylov and Podgoretskii is used to obtain an estimate of the size of the production region and the duration of the production process for secondary particles, R= (1.7 +- 0.3) x 10^{-13} cm and tau= (2.6 +- 1.7) x 10^{-24} sec.

56056 Two-pion correlations in $K^+ p$ interactions at 32 GeV/c. Azhinenko, I.V.; Blumenfeld, H.; Verbeure, F.; Vorob'ev, A.P.; Gerdyukov, L.N.; Gyssens, M.; Johnstad, H.; Csejthey-Barth, M.; Kubic, V.M.; Loret, M.; Lugovskii, S.B.; Manyukov, B.A.; Mosca, L.; Nguyen, N.K.; Skura, J.; Touchard, A.M.; Uvarov, V.A.; Schlesinger, J.; Shlyapnikov, P.V.; Scheuer, J. (French-Soviet and CERN-Soviet Collaborations). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 422-426(Oct 1977).

One- and two-particle inclusive distributions of π^- mesons from $K^+ p$ interactions at 32 GeV/c have been measured, and the correlations between π^- mesons in inclusive and semi-inclusive reactions are examined. Short-range correlations that are only weakly dependent on the secondary-particle multiplicity and the primary energy are detected.

56057 Multiplicity of secondary particles produced in interactions of 40-GeV/c π^- mesons with two or more nucleons in the carbon nucleus. Angelov, N.S.; Backovic, S.; Grishin, V.G.; Nagy, J.; Suleimanov, M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 426-429(Oct 1977).

Secondary-charged-pion multiplicity distributions of interactions of 40-GeV/c π^- mesons with several nucleons in the carbon nucleus are presented. Average π^{+-}-meson multiplicities of π^-(mN/sub p/) interactions with m=2, 3, and 4 are presented. The results are compared with cascade- and Glauber-model calculations. The results $<\nu> >$ or =1.50 +- 0.03 is obtained for the average number $<\nu>$ of interactions.

56058 (JINR—D1,2-10400(Vol.1), pp A2-6-A2-9) **Inclusive production of resonances and two-particle correlations in the $\pi^- N$ interactions at 40 GeV/c.** Grishin, V.G. 1977. (In Russian).

From 18. international conference on high energy physics; Tbilisi, USSR (15 Jul 1976).

In Proceedings of the 18. international conference on high energy physics. Vol. 1.

In the paper the results on the investigation of inclusive production of resonances and two-particle correlations of secondary particles in $\pi^- p$-interactions at p=40 GeV/c are presented. The main problem is the determination of probability of the rho^0-meson production and change of our presentation on two-particle azimuthal correlations of secondary pions with taking into account the resonance production. The experimental data on 11000 inelastic $\pi^- p$ interactions is obtained by the 2m propane bubble chamber irradiated on the Serpukhov accelerator.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

56059 (COO—3227-70) **Theory of high energy collision processes. Technical progress report, January 1, 1977—December 31, 1977.** (Harvard Univ., Cambridge, MA (USA). Gordon McKay Lab.). 1 Feb 1978. Contract EY-76-S-02-3227. 4p. Dep. NTIS, PC A02/MF A01.

Theoretical high energy physics is summarized. A list of publications is included. (JFP)

GENERAL

56060 Renormalization effects from superheavy Higgs particles. Toussaint, D. (Joseph Henry Laboratories, Princeton University, Princeton, N.J. 08540). *Phys. Rev., D;* **18**: No. 5, 1626-1631(1 Sep 1978).

Using a modification of the standard Weinberg-Salam model, we compute renormalization corrections to the W and Z masses proportional to differences in the Higgs-particle mass squared. This contradicts the expectation that superheavy particles should be undetectable in low-energy phenomena.

56061 Quark-antiquark interaction at all momentum transfers. Celmaster, W.; Henyey, F.S. (University of California, San Diego, La Jolla, California 92093). *Phys. Rev., D;* **18**: No. 5, 1688-1695(1 Sep 1978).

The running coupling constant of quantum chromodynamics, α/sub s/(q^2) is obtained for all q^2 by integrating the renormalization-group equation. The β function in the asymptotic- freedom region is given by perturbation theory through order g^5 and at large coupling by the string model with string tension related to the Regge slope α'. We incorporate these features into a Pade approximant to the β function thereby obtaining it for all g. The constant of integration Λ of the renormalization-group equation is chosen to be about 500 MeV, as required by deep-inelastic phenomenology. α/sub s/ is thus completely determined by α', Λ, and the first two terms of the β function. The resulting charmonium and Y spectroscopy is in excellent agreement with experiment. In particular the Y'-Y mass difference is forced to be nearly equal to the psi'-psi mass difference. In addition, it is shown that the structure of α/sub s/(q) signals the presence of instantons.

ELECTROMAGNETIC INTERACTIONS

56062 Simple dynamical model for $\gamma N \rightarrow \pi^{+-}\Delta$. Clark, R.B. (Department of Physics, Texas A M University, College Station, Texas 77840). *Phys. Rev., D;* **18**: No. 5, 1444-1450(1 Sep 1978).

An elementary phenomenological extension of the gauge-invariance- constrained dynamical amplitudes for $\gamma N \rightarrow \pi^{+-}\Delta$ is considered. The extended amplitudes are parameterized with a real (minimal gauge-invariant extension of one-pion-exchange) background term and simple Regge-pole forms. The two free parameters which both appear in the unnatural-parity-exchange component are determined by comparison with $d\sigma''/dt$ data for $\gamma p \rightarrow \pi^- \Delta^{++}$. The remainder of the natural-parity exchange is represented by rho and A_2 exchange. Predictions are made for $d\sigma/dt$ and Ξ, for the various charge states and the unnatural-parity-exchange components are well described in each case.

56063 Electromagnetic characteristics of leptons and CP violation in the SU (3) x U (1) model. Koval'chuk, V.A.; Rekalo, A.P. (Physicotechnical Institute, Ukrainian Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 2, 129-132(20 Jan 1978).

The electric dipole moments of leptons and the correction, for the weak interaction, to the anomalous magnetic moment of the muon are calculated in the SU (3) x U (1) model of the weak and electromagnetic interactions.

56064 Limits of validity for the Vavilov energy straggling calculation. Jarmie, N.; PINDZOLA, M.S. (LOS ALAMOS SCIENTIFIC LAB., N.MEX. (USA)); BICHSEL, H. (WASHINGTON UNIV., SEATTLE (USA)). *Comput. Phys. Commun.;* **13**: No. 5, 317-321(1978).

A discussion of the present situation on the calculation of the energy straggling of heavy charged particles in relatively thin absorbers is given. In particular, a guide for the regions of validity of the Vavilov formula is given; and a warning concerning the use of the computer program STRAGL is noted.

56065 New method of determining the magnetic moment of the electron. Sokolov, A.A.; Pavlenko, Y.G. (Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 560-562(Nov 1977).

The Pauli equation is solved for electrons moving in crossed magnetic and electrostatic fields of two different configurations. It is shown that the frequency shift of radiative dipole transitions is related to the anomalous magnetic moment. This fact can be used to determine experimentally the anomalous magnetic moment of the electron.

56066 Radiative decays of vector mesons in the relativistic harmonic oscillator model. Govorkov, A.B.; Drenska, S.B. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 446-450(Oct 1977).

Radiative M1 transitions both of ordinary vector mesons ω, rho^0, K^{0*}, and also of the new J/psi meson into pseudoscalar mesons π^0, eta, eta', and K^0 are discussed in terms of the relativistic model of a four-dimensional harmonic oscillator. The parameters of the oscillator were determined from the experimental data on the decay widths of vector mesons into a lepton pair. For the J/psi meson the relativistic effects lead to an appreciable additional suppression of radiative transitions.

56067 Emission of π^0 mesons by a proton in a constant electromagnetic field. Zhulego, V.G.; Radyuk, A.F.; Fedorov, F.I. (Physics Institute, Belorussian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 474-477(Oct 1977).

The exact wave function of the Dirac fermion is used to calculate, in the Furry formalism, the probability of emission of a neutral pseudoscalar pion by an unpolarized proton with a static anomalous magnetic moment μ_0 in a crossed constant and homogeneous electromagnetic field. The calculation is carried out in an approximation linear in $2\mu_0$ vertical-baravertical-bar. It is shown that in the nonrelativistic and ultrarelativistic limits of the proton energy, allowance for the proton anomalous magnetic moment leads to a substantial contribution to the probability of this process. This result proves the need for taking into account the anomalous magnetic moments of Dirac fermions in such processes.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 56063

56068 Charm contribution to neutrino-induced production of opposite-sign dimuons. Lai, C. (Fermi National Accelerator Laboratory Batavia, Illinois 60510). *Phys. Rev., D;* **18**: No. 5, 1422-1438(1 Sep 1978).

A systematic study of the charm contribution to the neutrino-induced opposite-sign dimuon events is presented. Theoretical predictions, taking into account the threshold effects, the experimental cuts and the beam spectrum, are compared with the CERN-Dortmund-Heidelberg-Saclay data. The behavior of the charmed-quark fragmentation function is also investigated.

56069 Decays of heavy pseudoscalar mesons. Rizzo, T.G. (Department of Physics and Astronomy, University of Rochester, Rochester, N. Y. 14627). *Phys. Rev., D;* **18**: No. 5, 1569-1577(1 Sep 1978).

The decays of pseudoscalar mesons containing heavy t or b quarks is discussed. In particular, we show that t or b production by neutrinos should not lead to any substantial increase in the observed dimuon rate above threshold.

56070 Problem of $D^0 \rightarrow K^- \pi^+ \pi^0$ in nonleptonic charm decay. Rosen, S.P. (Purdue University, West Lafayette, Indiana 47907). *Phys. Rev. Lett.;* **41**: No. 1, 3-6(3 Jul 1978).

If the branching ratio for $D^0 \rightarrow K^- \pi^+ \pi^0$, which currently stands at (12 +- 6) %, remains much larger than 3% in future data,then either the $\Delta T = 1$ rule breaks down, or the final-state K-bar$\pi\pi$ contains much structure. The possibility that this structure is due to K-bar* and rho resonances is briefly examined.

56071 Is the Y a bound state of exotic quarks. Yee Jack Ng; Tye, S.H. (Stanford Linear accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev. Lett.;* **41**: No. 1, 6-9(3 Jul 1978).

To explain the Y-Y' mass splitting of the recently discovered Y resonances, we interpret them as bound states of a quark and an antiquark which are not members of the fundamental (3) representation of color SU(3). A quark in the 8 or 6 representation is consistent with the data. We discuss some of its properties and the phenomenological consequences that follow from our suggestion.

56072 Gluon condensate and leptonic decays of vector mesons. Vainshtein, A.I.; Zakharov, V.I.; Shifman, M.A. (Institute of Theoretical and Experimental Physics). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 1, 55-59(5 Jan 1978).

We consider the power-law corrections to the asymptotic-freedom predictions for vacuum polarization by a photon. The corrections are determined by the square of the gluon-field stress tensor (gluon condensate) averaged over the vacuum. The analysis makes it possible to calculate the lepton widths of the rho^0 and phi^0 mesons. The results agree well with experiment.

56073 Neutral currents and photon emission in the reactions $\nu(\bar{\nu})N \rightarrow \nu(\bar{\nu})\nu N$. Choban, E.A.; Shekhter, V.M. (M. I. Kalinin Leningrad Polytechnic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 563-567(Nov 1977).

Estimates are made of the cross sections for photon emission in neutrino-nucleon and antineutrino-nucleon scattering due to neutral currents. Calculations are made in the single-nucleon approximation and in the vector-dominance model.

56074 Modification of the Kuti-Weisskopf parton model and deep inelastic lepton-nucleon scattering. Belokurov, V.V.; Isaev, P.S.; Malyshkin, V.G.; Kovalenko, S.G. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 567-570(Nov 1977).

It is shown that the Kuti-Weisskopf parton model is unstable with respect to infinitesimal perturbations of the single-particle parton distribution functions in the fraction of longitudinal momentum. A modification of the distribution functions is proposed, leading to results in better agreement with the experimental data.

56075 Weak neutral current in the inclusive annihilation $e^+e^- \rightarrow p+X$. Grigoryan, S.G.; Esaibegyan, S.V. (Erevan Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 440-442(Oct 1977).

Polarization effects in the inclusive process $e^+e^- \rightarrow p+X$ are studied within the framework of the Weinberg model. Expressions for the asymmetry parameters and the average polarization of the final particle are obtained in the quark-parton picture. The quark-gluon model of Farrar and Jackson is used for numerical estimates in the region $x \simeq 1$.

STRONG INTERACTIONS, GENERAL

56076 Diffraction scattering and the parton structure of hadrons. Miettinen, H.I.; Pumplin, J. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **18**: No. 5, 1696-1708(1 Sep 1978).

We apply parton-model concepts to the "soft" (small-momentum- transfer) processes which make up the majority of the hadronic total cross section. Diffraction is calculated as the shadow of these soft processes. We obtain an attractive picture of the essential features of total, elastic, and diffractive-inelastic scattering. In particular, the rather large cross section for inelastic diffraction, which is observed experimentally, results from fluctuations in the distribution of the wee partons which initiate interactions. These fluctuations lead to diffractive production by the mechanism of Good and Walker. The observed peripheral character of diffraction as a function of impact parameter, the absence of a forward dip in $d\sigma/dt\ dm^2$, the correct integrated cross section, and the correct small-t slope of diffraction all follow naturally in our approach.

56077 (JINR—D1,2-10400(Vol.1), pp C127-C128) **Hadronization of quark theories and bilocal QED.** Kleinert, H. (Freie Univ. Berlin (Germany, F.R.). Inst. fuer Theoretische Physik). 1977.

From 18. international conference on high energy physics; Tbilisi, USSR (15 Jul 1976).

In Proceedings of the 18. international conference on high energy physics. Vol. 1.

There are two approaches to strong interactions: colored quark gluon theory and the dual model. For the simplified situation where gluons are color synglets with an arbitrary mass an equivalence of both approaches is established. Using functional methods quantum flavour dynamics is transformed into an equivalent bilocal field theory, whose bare quanta propagate and interact just like hadrons in dual diagrams.

56078 (JINR—D1,2-10400(Vol.1), pp C108-C111) **Potential and quasipotential models for bound states.** Mir-Kasimov, R.M. 1977.

From 18. international conference on high energy physics; Tbilisi, USSR (15 Jul 1976).

In Proceedings of the 18. international conference on high energy physics. Vol. 1.

The application of the quasipotential approach to description of interactions between quarks is reported. There is a number of difficulties connected with the finite-difference character of the quasipotential equation. The main one is the problem of boundary conditions. The case of extremely heavy quark is also studied, which is suggested by the field-theoretical scheme in which the momenta of quanta off the mass shell belong to the de-Sitter space. In this case the attractive idea is to identify the quark with maximon. In such a case these particles originating due to the properties of the geometry of the momentum space are at the same time the fundamental constituents of hadrons.

STRONG INTERACTIONS, BARYON NO.=0

56079 **Variational method for boson scattering.** Bolsterli, M. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev., D;* **18**: No. 4, 1110-1112(15 Aug 1978).

The Hamiltonian for a scalar field interacting with a Schroedinger source is treated by coherent-state methods. It is shown that meson scattering can be calculated by a variational procedure.

56080 **Baryon-antibaryon bound states determined by the dispersion method.** Badalyan, A.M.; Narodetskii, I.M. (Institute of Theoretical and Experimental Physics, GKIAE). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 513-517(Nov 1977).

The N/D method is used to find the singlet levels in NN and NN-bar systems. Both static and nonstatic interactions given by the sum of single meson exchanges are considered. For both interactions the near-threshold $^1S_0$ levels in the NN-bar system with quantum numbers I/sup G/=0$^+$ and I/sup G/=1$^-$ are about 100 MeV below the threshold and only weakly dependent on the cutoff parameter.

56081 **Possibility of separating one-photon exchange in inelastic diffraction processes.** Azimov, Y.I.; Levin, E.M.; Ryskin, M.G.; Khoze, V.A. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 436-440(Oct 1977).

The problem of measuring the widths of radiative decays of resonances by determining the one-photon contribution to inelastic diffraction reactions is considered. The kinematic region in which this contribution can be separated is studied. The reaction $\pi p \to A_3 p$ is investigated in detail. Reactions with a helium target and the transition $\pi \to A_1$ are also discussed. It is shown that separation of the one-photon contribution becomes already possible at vertical-bart vertical-bar$\sim 10^{-3}$ GeV^2.

56082 **Asymptotic properties of p-barp annihilation in a simple parton model.** Moehring, H. (Nuclear Physics Institute, Siberian Division, USSR, Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 450-453(Oct 1977).

A physical picture of p-barp annihilation based on the quark-gluon model of Van Hove and Pokorski [Acta Phys. Pol. B5, 229 (1974); Nucl. Phys. B86, 243 (1975)] is proposed. The dominant reaction in these processes is assumed to be the annihilation of valence quarks q and antiquarks q-bar. The dependence of the total cross section for p-barp annihilation on the energy $\sqrt{s}$ is studied under various assumptions about the fundamental q-barq reaction. Kaon production in p-barp annihilation is also discussed in connection with electron-positron annihilation and inelastic p-barp and pp collisions.

56083 **Strange exotic meson resonances of the quasinuclear type in the mass range near 2 GeV.** Bogdanova, L.N.; Dal'karov, O.D.; Shapiro, I.S. (Institute of Theoretical and Experimental Physics). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 206-209(Aug 1977).

It is shown that the mass region near 2 GeV should contain strange exotic mesons in the form of quasinuclear bound and resonance states of the system ΣN-bar with isospin I=3/2. The theoretically possible widths of these mesons range between 10^{-2} and 10^2 MeV.

56084 (JINR—D1,2-10400(Vol.1), pp 105-108) **Radial excited mesons in the MIT bag model.** Kobsarev, I.Yu.; Matv'ev, V.Yu.; Schepkin, M.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1977.

From 18. international conference on high energy physics; Tbilisi, USSR (15 Jul 1976).

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The results of calculations of the masses of the radial excited mesons in the framework of the MIT bag model are presented. Corrections to the mass which comes from "magnetic" moment interaction are discussed. The model predictions for the masses of the first radial excited strange mesons are given. Among experimentally observed particles there are only two which can be identified as radial excitation in light mesons. They are rho' (1250) and rho' (1600). The model predicts two particles with masses of 1550 MeV and 1610 MeV, which corresponds to the first radial excitation of rho-type.

56085 (JINR—D1,2-10400(Vol.1), pp C114-C116) **New particle with the mass M=1110 MeV and vector meson spectrum in the relativistic model of quark confinement.** Skachkov, N.B. 1977.

From 18. international conference on high energy physics; Tbilisi, USSR (15 Jul 1976).

In Proceedings of the 18. international conference on high energy physics. Vol. 1.

A theoretical model that predicts the existence of a new vector meson with the mass of M=1100 MeV in the spectrum of the vector mesons was proposed earlier. The main feature of the model is the use of a new type of the potential that binds two quarks inside a meson. The rho-meson excited state spectra and I/PSI particle mass spectrum are considered. All three particles appearing in the mass spectrum of the model exist in nature, provided that the quantum numbers of new vector meson coincide with the quantum numbers of the rho-meson as the model predicts. The model requires more than one (charmed) heavy quark in order to describe the I/PSI particle spectrum.

STRONG INTERACTIONS, BARYON NO.=1

56086 **Phenomenology of high-momentum-transfer elastic processes.** Coon, D.D.; Gunion, J.F.; Tran Thanh Van, J.; Blankenbecler, R. (University of Pittsburgh, Pittsburgh, Pennsylvania 15213). *Phys. Rev., D;* **18**: No. 5, 1451-1468(1 Sep 1978).

An analysis is carried out to extract the leading effective trajectories and residues in pp and π^-p elastic scattering. The results are compared with the predictions of the constituent-interchange model and the logarithmic dual model, which are shown to be the only two types of theory capable of providing a uniform link between backward and forward Regge regions and the fixed-angle region. The hypothesis of a smooth connection between forward and backward Regge regions puts strong contraints on a priori unrelated trajectories and residues. The possibility of a connection between the two models is discussed. As expected from interchange theory the extracted π^-p trajectory and residue behave quite differently than those for pp. The dual model seems to give the best overall description of the pp trajectory and residue functions while the πp results agree completely with the interchange predictions. The two model fits to pp elastic scattering at moderate energies (12—24 GeV) are used to extract an expected Pomeron term. The shape of the extracted diffractive contribution is strikingly similar to the recent CERN ISR differential cross sections which exhibit a dip at t = - 1.4 GeV^2 and a slow falloff in the large-t region.

56087 **Electromagnetic form factor of the proton in the vector-dominance model with modifications at small distances.** Bilen'kaya, S.I.; Skachkov, N.B.; Solovtsov, I.L. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 556-559(Nov 1977).

The predictions of the vector-dominance model with modifications at small distances are compared with the available experimental data on elastic ep scattering. It is shown that better qualitative agreement is obtained if allowance is made for the contribution from the central part of the proton with radius equal to its Compton wavelength.

56088 **Difference of the average multiplicities of charged particles in π^{+-}p and pp collisions according to the quark model.** Anisovich, V.V. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 571-572(Nov 1977).

Using quark combinatorics, it is shown that the fragmentation production of particles by protons should be greater than the fragmentation production by pions at high energies (p/sub lab/ >100 GeV/c).

56089 Chiral dynamics and asymptotic restrictions for πN and πK scattering. Bolokhov, A.A.; Vereshchagin, V.V. (Leningrad State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 588-592(Nov 1977).

It is shown that in the framework of chiral dynamics the requirement that πN and πK scattering amplitudes should be bounded leads to systems of sum rules for masses and coupling constants. One of these is satisfied exactly up to errors in the experimental data. An analysis of the other sum rules shows that they are consistent with the existing experimental data, make it possible to determine the off-mass-shell $\pi N\Delta_{33}$ coupling constant Z, require the existence of a κ meson, and relate the "trace" πKK coupling constant to the $K\rightarrow K\pi$ decay width.

56090 Remarks on the cross section for rho^0-meson production in multi-particle production processes. Volkov, E.I.; Kanarek, T.I. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 597-598(Nov 1977).

The dependence of multiple production cross sections on multiplicity is discussed for two versions of the multiperipheral model.

56091 Feynman-gas model for semi-inclusive processes. Levin, E.M.; Ryskin, M.G.; Troyan, S.I. (Leningrad Nuclear Physics Institute, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 453-458(Oct 1977).

An analytic formula is proposed to allow for the effect of the energy-momentum conservation law on semi-inclusive spectra in a Feynman-gas (FG) model. The leading-particle effect is discussed. It is shown that both the multiperipheral model (MM) and the quark model (QM) well explain the asymmetry of inclusive spectra in πp interactions (R=3/2). These two factors (the conservation law and leading-particle effect) enable us to fit the variation of semi-inclusive spectra with increasing multiplicity. The rate of increase of the slope of the inclusive cross section, dσ/sub n//dk^2/sub perpendicular/proportionalexp(-b/sub n/k^2/sub perpendicular/), with increase of the multiplicity depends mainly upon the degree of repulsion between neighboring FG particles. The experimentally observed increase of the slope agrees well with the MM predictions and is a strong argument in favor of the existence of negative dynamic correlations.

56092 Multiperipheral model with heavy clusters and description of processes with fast Λ^0 hyperons in K^-p interactions. Arestov, Y.I. (Institute of High Energy Physics, Serpukhov). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 458-462(Oct 1977).

The reactions $K^-p\rightarrow\Lambda+$ pions with hypercharge annihilation and $K^-p\rightarrow\Lambda$p/sub slow/+X with production of a Λ—antinucleon pair are investigated on the basis of the latest data on the inclusive reaction $K^-p\rightarrow\Lambda X$ at 32 GeV/c (Yu. I. Arestov et al. Preprint M-29, Institute of High Energy Physics, 1976 and paper submitted to Eighteenth International Conference on High Energy Physics, Tbilisi, July 1976). These reactions explain the appreciable fraction of the fast (in the l.s.) Λ particles observed in experiment. The problem of production of fast baryons in meson-nucleon collisions is discussed. A multiperipheral mechanism with heavy clusters is proposed to explain the experimental data in K^-p interactions at 14.3 and 32 GeV/c. Predictions are made for 70 GeV/c. A similarity between the energy dependences of the annihilation of the hypercharge, baryon charge, and leptonic "charge" is established.

56093 (JINR—D1,2-10400(Vol.1), pp C122-C125) **Bound and resonant states in the nucleon-antinucleon system.** Shapiro, I.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1977.

From 18. international conference on high energy physics; Tbilisi, USSR (15 Jul 1976).

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A possibility of existence of relatively long-living quasinuclear states of the N anti N system was shown theoretically earlier. The modern states of the problem are reviewed. γ radiation accompanies the annihilation of antiprotons. This radiation is found in anti p d annihilation. There are anomalies in annihilation of slow antiprotons. Rather intensive annihilation from triplet p states of anti pp and anti pd atoms is observed as well as deviation from the 1/v low for slow anti p. There was direct discovery of heavy "quasinuclear" anti NN mesons. Resonant N anti N states are seen in the energy behaviour of the anti pp and pd total cross sections and in the large angle anti pp elastic scattering cross sections.

56094 πp p elastic scattering near 1400 MeV C.M. energy. Lima, C.A.S. (BRASILIA UNIV. (BRAZIL). DEPARTAMENTO DE FISICA); GREENBERG, M. (CALIFORNIA UNIV., BERKELEY (USA). LAWRENCE BERKELEY LAB.). *Rev. Bras. Fis.;* **6**: No. 1, 117-125(Apr 1976).

An analysis of the experimental data, obtained in the Saclay 180-liter liquid hydrogen bubble chamber, on π^-p elastic scattering, at energies spanning the region of the $P_{11}(1470)$ resonance, is presented. Scattering angular distributions, obtained by following the procedures outlined in the text, are exhibited.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

56095 Proton-proton total cross sections from cosmic ray data. Nam, R.A.; Nikol'skii, S.I.; Starkov, N.I.; Tsarev, V.A.; Chubenko, A.P.; Yakovlev, V.I. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 550-555(Nov 1977).

Calculations are presented for corrections to inelastic screening in particle scattering on nuclei. A method is described for converting nuclear cross sections into nucleon cross sections, and vice versa. It is used to extract the proton-proton interaction total cross section from cosmic ray data, and the results are compared with the predictions of various models. The effect of the choice of the nuclear wave function on the energy dependence of the cross section is examined.

56096 Absorptive parts of the hadron-nucleus amplitude and multiparticle production in nuclei. Shabel'skii, Y.M. (Leningrad Nuclear Physics Institute, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 573-578(Nov 1977).

Hadron-nucleus interactions are considered in the framework of the Glauber model. Inelastic screening is taken into account in a two-channel model. It is shown that the inelastic cross sections are associated with the cutting of different numbers of hadron-nucleon clusters in the elastic scattering amplitude. The relations between the contributions to the absorptive part of the amplitude from different types of cuts satisfy the Abramovskii-Gribov-Kancheli rules up to a factor determined by the ratio of the inelastic hadron-nucleon cross section to the total cross section. The inclusive spectrum is in its central region proportional to A/sup 1/3/. The average charged-particle multiplicity increases with A more slowly than A/sup 1/3/ when energy conservation is taken into account. Good agreement is obtained with the experimental data on the average multiplicity and on the charged-particle distributions from nuclei.

56097 Multiplicity of secondary particles in hadron-nucleus interactions and the Kalinkin-Shmonin cluster model. Gulamov, K.G.; Uzhinskii, V.V. (Physico-technical Institute, Uzbek Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 579-583(Nov 1977).

The energy dependence and A-dependence of the average multiplicities of various types of secondary particles are studied in the framework of the Kalinkin-Shmonin single-cluster model. It is shown that there is no set of parameters of the model which gives a simultaneous description of these dependences in hadron-nucleus collisions.

56098 Multiple production on nuclei in the parton-hadron cascade model. Voloshin, S.A.; Emel'yanov, V.M.; Nikitin, Y.P. (Moscow Engineering Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 584-588(Nov 1977).

Multiple production processes in interactions of high-energy hadrons with nuclei are treated in terms of the two-phase parton-hadron cascade model. An analytic solution of the equation for the development of a one-dimensional parton-hadron cascade in a nucleus is obtained, and it is shown analytically that the rapidity distribution of the secondary hadrons has a minimum near the rapidity y=ln(2R/b), where R is the nuclear radius and b is a model parameter related to the parton lifetime.

56099 Collisions of relativistic nucleons with nuclei and equation of state for superdense matter. Tarasov, Y.A. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 405-414(Oct 1977).

Multiparticle production in collisions of relativistic nucleons with nuclei is treated by the hydrodynamical "tube" model. The problem is solved for arbitrary sound velocities. The calculation shows that the peak of the angular distribution of secondary particles in the c.m.s. is shifted toward angles >90 deg, i.e., the number of particles in the fragmentation region of the target nucleus increases considerably. This shift depends on the "tube" length and on the sound velocity in the compressed matter. A similar asymmetry is detected experimentally in collisions of 200-GeV nucleons with emulsion and hydrogen nuclei (Batavia, USA). The sound velocity in the superdense matter (of density about 100 nuclear densities) is estimated by comparing the experimental and theoretical values of these shifts. The best estimate for the sound velocity is between 0.6 and 0.7, corresponding to an equation of state somewhat stiffer than

in the asymptotically free case or in the case of a baryon ensemble with a power law density of resonance states.

56100 Cumulative production of pions in hadron-nucleus collisions. Gorenshtein, M.I.; Zinov'ev, G.M.; Shelest, V.P. (Institute of Theoretical Physics, Ukrainian Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 414-418(Oct 1977).

The available experimental data are described on the basis of a model in which the appearance of cumulative pions is connected with decays of clusters moving through the nucleus, and a number of predictions that lend themselves to an experimental verification are made.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

GENERAL

56101 Multiplicative baryon-number conservation and the oscillation of hydrogen into antihydrogen. Feinberg, G.; Goldhaber, M.; Steigman, G. (Department of Physics, Columbia University, New York, New York 10027). *Phys. Rev., D;* **18**: No. 5, 1602-1606(1 Sep 1978).

Interactions are considered that would allow the transformation of baryons into leptons with a multiplicative conservation law. One such interaction woulld transform hydrogen atoms into antihydrogen atoms. It is shown that on the basis of nonobservation of annihilation gamma rays from hydrogen-antihydrogen annihilation in HI regions of our galaxy, an upper limit for the strength of such interactions is 10^{-21} G/sub F/. Other sources of upper limits on such interactions are presented also.

56102 General regularities of fragmentation of single-particle states in deformed nuclei. Malov, L.A.; Solov'ev, V.G. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 384-389(Oct 1977).

We have used a model based on the interaction of quasiparticles with phonons to study the general regularities of the fragmentation of single-particle states in deformed nuclei. We have calculated the fragmentation of a large number of hole, ground, and particle states for many nuclei lying at the beginning, in the middle, and at the end of the region $150<A<190$. We have shown that the shape of the fragmentation of a single-particle state differs considerably from the Breit-Wigner distribution. The fragmentation depends substantially on the location and quantum numbers of the single-particle state and on the characteristics of the collective excitations.

56103 (JINR—D1,2-10400(Vol.1), pp C125-C127) **Bilocal functional approach to dynamical symmetry breaking.** Ebert, D.; Pervushin, V.N. 1977.

From 18. international conference on high energy physics; Tbilisi, USSR (15 Jul 1976).

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The Abelian gauge theory of massless fermions ("quarks") interacting with a massless neutral vector ("gluon") field is considered. The Green two-particle functions of the quarks and vector gluons are computed. The graphical expression of the bilocal propagator and that of different terms in the expansion of path integrals for these functions are given.

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

56104 (COO—3065-198) **Classification of gauge groups for unified weak and electromagnetic interactions.** UR-654. Okubo, S. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). 19 Apr 1978. Contract EY-76-C-02-3065. 17p. Dep. NTIS, PC A02/MF A01.

General structure of the gauge group C underlying the unified weak and electromagnetic interactions, assuming that G is compact and that all quarks have only electric charges 2/3 and -1/3. Then, it is proven that G cannot contain any exceptional Lie groups G_2, F_4, E_6, E_7, and E_8 as its factor. Moreover, the underlying representations for quark multiplets to be used must be one of fundamental representations for each component simple Lie group contained as a factor of G. For example, only spinor representation is allowed for SO(2l + 1) groups. If G is semi-simple in addition, then G must be a product of SU(3l) groups. This latter fact is likely in conflict with the present experimental data.

56105 T violation in SU(2) x U(1) gauge theories of leptons. Donoghue, J.F. (Department of Physics, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Phys. Rev., D;* **18**: No. 5, 1632-1643(1 Sep 1978).

Theories are studied in which violation of time-reversal invariance occurs in the leptons due to complex gauge couplings. We study under what conditions T violation may be present in a theory, and give three SU(2) x U(1) models (including an extension of the Cheng-Li model) to serve as examples of general classes of models. The electric dipole moment of the electron and T-violating correlations in leptonic decays are discussed. In general T-violating effects are difficult to observe even if the T-violating parameters are large. However, if heavy neutral leptons are found in neutrino scattering, a relatively simple T-violation test is discussed.

56106 Neutral-current constraints on gauge theories. II. Rizzo, T.; Mathur, V.S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Phys. Rev., D;* **18**: No. 5, 1647-1660(1 Sep 1978).

We extend the analysis of our SU(2) x U(1) model to the case of the ambidextrous SU/sub L/(2) x SU(2)/sub R/ x U(1) model and SU(2) x U/sub L/(1) x U/sub R/(1) models of the vector type. In the first case, we find that the only model of this kind that can fit the present neutral-current data is the standard doublet model. In the latter case, we find that vector models are ruled out.

56107 Weak charges of charmed particles. Buccella, F. (ROME UNIV. (ITALY). ISTITUTO DI FISICA); PUGLIESE, A. (BARI UNIV. (ITALY). ISTITUTO DI FISICA); SCIARRINO, A. (NAPLES UNIV. (ITALY). ISTITUTO DI FISICA); SORBA, P. (FERMI NATIONAL ACCELERATOR LAB., BATAVIA, ILL. (USA)). *Lett. Nuovo Cim.;* **16**: No. 18, 549-554(28 Aug 1976).

The matrix elements between the lowest states of the $\Delta C=1$ weak charges are evaluated including the effect of SU_4 breaking. The charges are obtained from the corresponding generators of the classification group by a unitary transformation U, which is factorized as the product of operators acting on a single quark: the breaking is naturally introduced by having different mixing parameters for the different quarks.

APPLICATIONS TO STRONG INTERACTIONS

56108 (JINR—D1,2-10400(Vol.1), pp C129-C159) **Composite models of hadrons and relativistic bound states.** Filippov, A.T. 1977.

From 18. international conference on high energy physics; Tbilisi, USSR (15 Jul 1976).

In Proceedings of the 18. international conference on high energy physics. Vol. 1.

The following problems are considered: what the constituents of the hadrons are; what their quantum numbers and their broken and unbroken symmetries are; what the dynamics of the constituents (equations, binding forces and the origin of symmetry violations) is. The most puzzling question is: why the constituents "escape from freedom" and are confined inside the hadrons; what experimentalists can report about the hadron constituents and their dynamics if not finding them. There are no final answers to all these questions. The achievements of quark model are described, some problems concerning the comparison of the quark model with experiment are considered. The attempt is also made to present alternative views on the same problems.

FIELD THEORY

56109 Multimeron field configurations. Jacobs, L.; Rebbi, C. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Phys. Rev., D;* **18**: No. 4, 1137-1143(15 Aug 1978).

We perform a numerical computation of multimeron solutions to the Yang-Mills equations. Assuming rotational symmetry about a fixed axis, multimeron field configurations are described by a single nonlinear partial differential equation over the complex plane. The covariance properties of this equation under Moebius transformations are discussed and used to simplify the numerical analysis. A variatinal procedure is then employed to evaluate the four-meron solutions and determine their properties.

56110 High-energy behavior of fermion-meson and meson-meson scattering in a supersymmetric field theory. Opoien, J.W. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50011). *Phys. Rev., D;* **18**: No. 4, 1332-1334(15 Aug 1978).

The high-energy behavior of fermion-boson and boson-boson scattering amplitudes of a supersymmetric field theory containing a spin-1/2 fermion field, a scalar field, and a pseudoscalar field is investigated. The results can be easily modified to apply to the Yukawa model and the neutral version of the linear σ model. The results are also compared to those of fermion-fermion scattering in the same model. In the leading-logarithm approximation, ladders with fermions running along the sides in the t channel and mesons as rungs dominate in each order of two classes of diagrams. The sum of the dominant series give rise to fixed Regge cuts for all amplitudes in

each of the three theories. All amplitudes in the supersymmetric theory possess a definite signature factor, while the amplitudes for fermion-fermion and fermion-antifermion scattering in the Y model and the σ model lack it. The results of the supersymmetric theory are also compared to the results of the spontaneously broken non-Abelian gauge theory.

56111 Example of nontrivial interaction of solitons in two-dimensional classical field theory. Zakharov, V.E.; Mikhailov, A.V. (Institute of Automation and Electronics, Siberian Division, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 1, 42-46(5 Jan 1978).

It is shown that in the model of the principal chiral field on the SU (N) group with N> or =3 there are soliton solutions with nontrivial interaction (mutual transformation) of solitons.

56112 Static gluon potentials in SU(3) -symmetric gauge theory. Protogenov, A.P. (Institute of Applied Physics, Academy of Sciences of the USSR, Gor'kii). *Sov. Phys. - Dokl. (Engl. Transl.);* **23**: No. 1, 46-48(Jan 1978).

Spherically symmetric solutions to the dual equations are found.

56113 Renormalization group equation for composite fields. Grigoryan, R.P.; Tyutin, I.V. (Erevan Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 593-596(Nov 1977).

The renormalization group equation for the generating functional of the Green function is derived in a theory including phi^2 type composite fields (phi is a Bose field). The asymptotics of the effective potential in asymptotically free theories are found. It is shown on the example of a theory of a Yang-Mills field, interacting with a fermion field, that the requirement of stability of the theory (i.e., that the potential be bounded from below) leads to constraints on the multiplet content of the fermions. Arguments are given indicating that a dynamic mass must appear for some particles in a stable asymptotically free gauge field theory with vanishing bare masses.

56114 Classical solutions of the field equations. Konopel'chenko, B.G. (Nuclear Physics Institute, Siberian Division, USSR Academy of Sciences, Novosibirsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 598-599(Nov 1977).

Several solutions to the four-dimensional sine-Gordon equation are presented including that for the t Hooft-Polyakov monopole.

56115 Calculation of the Weinberg angle in unified theories of the strong, electromagnetic, and weak interactions. D'yakonov, D.I. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 443-445(Oct 1977).

A formula is derived for the Weinberg angle in the case of an arbitrary group G which unifies the three types of interactions. This formula leads to definite restrictions on the numbers of quarks and leptons and on their charges. In particular, it is shown that an incorrect value of the Weinberg angle is given in previous papers [F. Guersey and P. Sikivie, Phys. Rev. Lett. 36, 775 (1976). P. Ramond, Nucl. Phys. B110, 214 (1976)] concerned with the exceptional group E_7. The possibility of dynamical symmetry breaking at very small distances is discussed.

56116 Quantum theory of the Polyakov—'t Hooft monopole. Vergeles, S.N.; Khokhlachev, S.B. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 463-467(Oct 1977).

Perturbation theory is developed for the wave functions of the monopole and the dyons in a gauge theory with a gauge SU (2) group and a Higgs triplet of particles. Both small and large dyon charges are considered. Excited states of the monopole with nonzero spin are found.

56117 New instanton solutions in field theory. Laperashvili, L.V.; Ushveridze, A.G. (Physics Institute of the Academy of Sciences of the Georgian SSR, Tbilisi). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 467-470(Oct 1977).

New instanton solutions with unit topological charge have been obtained for scalar isotensor fields transforming according to the irreducible representations of the group O (D), where D is the dimension of coordinate space, as well as for the system of interacting isovector and gauge fields.

56118 Quantum-mechanical picture of a multi-particle reggeon with α (0) >1. Matinyan, S.G.; Sedrakyan, A.G. (Erevan Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 470-473(Oct 1977).

The quantum-mechanical problem of a multiparticle bound state with maximum angular momentum that depends quadratically on the number of particles is studied from the point of view of the multiparticle reggeon considered previously by the authors [S.G. Matinyan and A.G. Sedrakyan, Pis'ma Zh. Eksp. Teor. Fiz. 23, 588 (1976) [JETP Lett. 23, 538 (1976)]; Yad. Fiz. 24, 844 (1976) [Sov. J. Nucl. Phys. 24, 440 (1976)]]. The conditions under which the intercept of such a reggeon is greater than unity are discussed.

56119 Connection between strong-field quantum electrodynamics with short-distance quantum electrodynamics. Ritus, V.I. (P. N. Lebedev Physical Institute of the USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 3, 423-430(Sep 1977).

The exact Lagrange function of a constant electromagnetic field is considered as a competitor for the photon propagator in the investigation of questions of principle in quantum electrodynamics. A condensed gauge-invariant method is proposed for the calculation of radiative contributions to the Lagrange function, based on a closed functional expression. For extremely strong fields all radiative effects are concentrated in a scale multiplier of the field variable which is universal for quantum electrodynamics (or the Callan-Symanzik β function). In addition to the expansion terms of the β function in spinor electrodynamics which were determined before, we have obtained the first two terms in its expansion for scalar electrodynamics. A comparison is carried out between the renormalization-invariant charges determined by the photon propagator and the Lagrange function and the bare charge determined by the Z_3-factor. It is proved that their Gell-Mann—Low functions are different, the latter containing α^3 terms which makes the appearance of a common zero in these functions possible; this corresponds to a finite limit charge. Integral transformations of the renormalization-invariant charges are considered, which do not change their boundary and limit values, but subject their Gell-Mann—Low function to a transformation.

56120 "Instantons" of higher order. Burlankov, D.E.; Dutyshev, V.N. (Gor'kii State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 197-199(Aug 1977).

Solutions have been obtained for the Yang-Mills equations for the gauge group SU (2) in a Euclidean space having a topological characteristic larger than one.

SCATTERING THEORY

56121 One-boson exchange potentials in relativistic configuration space. Skachkov, N.B.; Solovtsov, I.L. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 367-371(Oct 1977).

A relativistic system of two fermions is considered. As quasipotentials we have taken one-boson exchange potentials converted to three-dimensional form in Lobachevskii space. A transition to relativistic coordinate space is made. A relativistic generalization of spin-orbit and tensor forces is suggested.

PHYSICS RESEARCH (CONT.)

EXPERIMENTAL TECHNIQUES

56122 Experiment on neutrino storage in a magnetic trap. Kosvintsev, Y.Y.; Kushnir, Y.A.; Morozov, V.I.; Plotnikov, I.A. *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 1, 65-68(5 Jan 1978).

Preliminary results are reported of an experiment on the containment of ultracold neutrons (UCN) (0—9 neV) in a magnetic trap with field intensity 25 kOe. The number of neutrons accumulated in the trap is 1.05 +- 0.15, and the storage time is 35 +- 10 sec.

56123 Monochromatization of polarized neutrons by the method of spatial spin resonance. Agamalyan, M.M.; Drabkin, G.M.; Lebedev, V.T. (Leningrad Nuclear Physics Institute, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 200-202(Aug 1977).

A description is given of a magnetic monochromator for polarized neutrons which is capable of separating out from the spectrum of thermal neutrons narrow monochromatic lines of different prescribed halfwidths $\Delta\lambda$/sub 1/2//λ. The aperture ratio of the monochromator is not less than 90%; the readjustment from one wavelength to another is attained by varying the direct current which gives rise to the activating magnetic field H_0 of the resonator. The use of multilayer iron-cobalt polarizing mirrors included in the design of the monochromator ensures that the polarization of a nonmonochromatic neutron beam is ~96%.

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

MASS, ABUNDANCE, AND BINDING ENERGY

56124 Triton binding energy. Kirzhnits, D.A.; Takibaev, N.Z. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 1, 69-71(5 Jan 1978).

A simple formula is derived for the triton binding energy and yields an estimate ≃8 MeV (as against the experimental 8.5 MeV).

NUCLEAR REACTIONS AND SCATTERING

56125 Method of hyperspherical functions in problems with continuous spectrum. Three-particle photodisintegration of ^{3}H and ^{3}He. Vostrikov, A.N.; Zhukov, M.V. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 377-378(Oct 1977).

The three-particle photodisintegration total cross sections of H^3 and ^{3}He nuclei are calculated for the electric dipole transition to the final state with isospin T=3/2. Wave functions of the discrete and continuous spectra are constructed with the method of hyperspherical functions. For total cross sections calculated with realistic potentials, good agreement with experiment is obtained.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

56126 Neutron focus in beryllium in a synchrotron-radiation field. Eremeev, I.P. *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 1, 10-14(5 Jan 1978).

It is shown that in a synchrotron-radiation field it is possible to generate pulsed photoneutron fluxes of unprecedented space-time and spectral density. Possible new experiments are indicated.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

56127 (BNL-NCS—50681, pp 135-150) **Neutron spectra from 30-MeV deuterons on a thick beryllium target.** Nethaway, D.R. (Lawrence Livermore Lab., CA); Van Konynenburg, R.A.; Guinan, M.W.; Greenwood, L.R. Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

The neutron spectra were measured produced by bombarding a thick beryllium target with 30-MeV deuterons at the University of California, Davis cyclotron. These spectra are of interest in studying the effect of neutrons on materials to be used in future fusion reactors. The spectra were inferred from the activation of two sets of detector foils placed at an angle Theta = 0^{0} to the deuteron beam, one immediately behind the beryllium target block, and one 40 mm to the rear. We used the SAND-II program to analyze the foil activation data to obtain the fluence in each of one hundred energy groups. The neutron spectrum (fluence/MeV) close to the target decreases continuously with energy in the range 2 to 30 MeV, while the spectrum 40 mm back has a minimum at about 8 MeV and a peak at about 14 MeV. The contribution from neutrons of energies less than 10 MeV is much greater than that found in previous spectral measurements made at large distances from the target. This difference is attributed to the neutrons which are emitted at large angles from the deuteron beam. These observations show the importance of evaluating the neutron spectrum near the target if samples of materials are to be irradiated in this location.

56128 (^{3}He, ^{4}He) reaction in the carbon isotopes. Adeev, G.D.; Kazantseva, A.M.; Kozyr', V.V.; Matusevich, V.A.; Chernov, I.P. (Institute of Nuclear Physics at Tomsk Polytechnic Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 361-365(Oct 1977).

Differential cross sections have been measured for the reaction (^{3}He, ^{4}He) in the ^{12}C nucleus at ^{3}He ion energies of 18, 20, and 24.5 MeV, and in the ^{13}C nucleus at 18 and 20 MeV, with formation of the final nuclei in the ground and first excited states. A theoretical analysis of the cross sections was carried out by the distorted-wave method. The differential cross sections in ^{13}C are qualitatively described by the DWBA on the assumption of a neutron-pickup mechanism. For the reaction ^{13}C(^{3}He, ^{4}He)^{12}C agreement between theory and experiment was obtained for R/sub c/not =0. It is noted that the agreement between theory and experiment is improved if the finite range of the interaction is taken into account for the reaction in ^{13}C and remains as before in the case of the reaction in ^{13}C.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

56129 Measurement of total neutron cross sections of the isotopes ^{54}Fe and ^{56}Fe by the time-of-flight method in the energy range 1—70 keV. Vinogradov, V.N.; Gai, E.V.; Glukhovets, A.N.; Rabotnov, N.S.; Stupak, A.I.; Tarasko, M.Z.; Shcherbakov, O.A. (Physics and Power Engineering Institute, Obninsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 494-497(Nov 1977).

Total neutron cross sections have been measured for the isotopes ^{54}Fe and ^{56}Fe in the region from 1 to 70 keV with a resolution of 8 nsec/m. Pade approximations of type II were used to analyze the cross sections in the resonance region. Values of the resonance parameters are given.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

56130 Spatial distribution of nucleons in ^{90}Zr and ^{208}Pb nuclei from experiments on elastic scattering of 1-GeV protons. Alkhazov, G.D.; Belostotskii, S.L.; Vorob'ev, A.A.; Volkov, S.S.; Dotsenko, Y.V.; Domchenkov, O.A.; Kuropatkin, N.P.; Nikulin, V.N.; Shuvaev, M.A. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 357-361(Oct 1977).

Differential cross sections for elastic scattering of 1-GeV protons have been measured for the nuclei ^{90}Zr and ^{208}Pb. The experimental data are analyzed in terms of Glauber diffraction theory. The parameters of the spatial distributions of the density of nuclear matter and the parameters of the neutron distribution have been determined. The difference found for the rms radii of the neutron and proton distributions $\Delta=\langle r^2\rangle$/sub n//sup 1/2/—$\langle r^2\rangle$/sub p//sup 1/2/ in ^{90}Zr and ^{208}Pb is respectively $\Delta_{90}=0.09$ +- 0.05 F and $\Delta_{208}=0.03$ +- 0.05 F.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 56131

NUCLEAR REACTIONS AND SCATTERING

56131 (COO—2479-11) **Neutron capture cross section measurements of ^{99}Tc up to 80 keV.** Little, R.C.; Block, R.C. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Nuclear Engineering). 1977. Contract EY-76-S-02-2479. 4p. (CONF-770611—10). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; New York, NY, USA (12 Jun 1977).

Capture and transmission measurements were carried out. Eight new resonances were observed below 1.1 keV. Twenty-one new resonances were seen above 1.1 keV. Energy levels and integrated resonance yields are tabulated. The capture yield divided by sample thickness is shown; data were corrected for self-shielding and multiple scattering. ENDF data underpredict the cross section by about 15%. 1 figure, 1 table. (RWR)

56132 Radiative decay of unbound states of niobium in reactions induced by fast neutrons. Kozyr', Y.E.; Prokopets, G.A. (Kiev State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 489-493(Nov 1977).

From analysis of nγ coincidence spectra we obtained differential cross sections $d^2\sigma$/sub n/(70^{0})/dEdΩ for formation of neutrons in the reactions ^{93}Nb(n,n'γ) and ^{93}Nb(n,γn') at $E_0=14.6$ MeV. The measurements were made by the time-of-flight method. Inelastic scattering amounts to an appreciable fraction in the spectrum of all emitted neutrons up to E/sub n/=4 MeV, and its cross section is σ(n,n'γ) ≃320 mb. It is shown that radiative decay of unbound states is partially described in terms of the simple statistical model of a compound nucleus, which reproduces the competition of neutron and γ-ray emission at least in the excitation-energy region up to 2 MeV above the nucleon-emission threshold. The low-energy part of the neutron spectrum with E/sub n/<4 MeV is due to the process (n,γn'), for which the cross section is σ (n,γn') ≃ 214 mb. For interpretation of this result we have developed a model of preequilibrium γ emission, which also has been used successfully in

calculations of the γ spectrum and total cross section for capture of 14-MeV neutrons by niobium.

56133 Fast-neutron capture cross sections for indium, tantalum, gold, samarium, and europium. Kononov, V.N.; Yurlov, B.D.; Poletaev, E.D.; Timokhov, V.M. (Physics and Power Engineering Institute, Obninsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 500-504(Nov 1977).

Neutron radiative-capture cross sections for ^{115}In, ^{181}Ta, ^{197}Au, $_{62}$Sm, /sup 147,149/Sm, $_{63}$Eu, and /sup 151,153/Eu measured by the time-of-flight method in the neutron-energy region 5—350 keV have been analyzed in terms of statistical nuclear-reaction theory. Neutron and radiative strength functions are obtained for neutrons with orbital angular momentum l=0, 1, and 2.

SPONTANEOUS AND INDUCED FISSION

56134 Angular distributions of fission fragments and angular momentum of the fissioning nucleus in reactions induced by oxygen ions. Dmitriev, V.D.; Obukhov, A.I.; Perfilov, N.A.; Shigaev, O.E. (V. G. Khlopin Radium Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 505-508(Nov 1977).

Solid-state track detectors were used to study the angular distributions of fission fragments obtained in bombardment of nuclei from Ag to U by 137-MeV oxygen ions. A method of calculating the angular anisotropy is discussed which does not require calculations of the nuclear temperature at the saddle point. The possibility is considered of using the experimental data on fragment angular distributions for determination of the limiting values of angular momenta of fissioning nuclei.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 56133

56135 Spin dependence of the ^{165}Ho total cross section in the neutron-energy region from 4 eV to 100 keV. Akopyan, G.G.; Alfimenkov, V.P.; Veshbitski, Y.; Ivanenko, A.I.; Mareev, Y.D.; Moreva, N.I.; Ovchinnikov, O.N.; Pikel'ner, L.B.; Sharapov, E.I. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 497-500(Nov 1977).

The method of transmission of polarized neutrons through a polarized target at the IBR-30 pulsed reactor has been used to measure the spin dependence of the total cross section of ^{165}Ho in the neutron-energy region from 4 eV to 100 keV. Spins are obtained for 55 neutron resonances up to an energy of 310 eV. In the region of the averaged cross section the spin dependence of the s-wave neutron strength function has been determined: (S°/sub +/—S°/sub -/)/S° =—0.11 +- 0.04.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 56134

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 56130

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 56134

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

SPONTANEOUS AND INDUCED FISSION

56136 Fission of cold and heated californium nuclei. Istekov, K.K.; Kupriyanov, V.M.; Fursov, B.I.; Smirenkin, G.N. *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 2, 126-129(20 Jan 1978).

A comparison of the data on the fission probability in the reactions (n, f) and (I, xn) for the californium isotopes has established that strongly heated nuclei correspond to a liquid-drop-model fission barrier with approximate height 2 MeV, a height lower by a factor of more than 2.5 than the fission barrier for cold californium nuclei. This conclusion is supported by an analysis of a large aggregate of data on the Γ/sub f//Γ/sub n/ ratio.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

56137 (JINR—D7-9734) Proceedings of the International School-Seminar on reactions of heavy ions with nuclei and synthesis of new elements. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1976. 298p. (English and Russian). (CONF-750938—). Dep. NTIS (US Sales Only), PC A13/MF A01.

From Seminar on reactions of heavy ions with nuclei and synthesis of new elements; Dubna, USSR (23 Sep 1975).

The Proceedings include lectures on such problems as transuranic and superheavy elements, the mechanism of heavy ion-induced reactions, nuclear spectroscopy, prospects for the construction of new heavy ion accelerators, etc. Due to the size limitation, the Proceedings include only 27 of the lectures given.

RADIOACTIVE DECAY

56138 Study of γ radiation accompanying α decay of ^{235}U and β^- decay of ^{231}Th. Baranov, S.A.; Shatinskii, V.M.; Zelenkov, A.G.; Pchelin, V.A. (I. V. Kurchatov Atomic Energy Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 486-488(Nov 1977).

Semiconductor detectors and electronic equipment have been used to study the γ radiation accompanying the radioactive decay of ^{235}U and ^{231}Th. 102 γ lines were served in the γ spectra. A combined analysis of the spectra obtained permits assignment of 50 of them to α decay of ^{235}U, and the remaining γ lines are due to the β^- decay of the thorium isotope indicated. Many of the observed γ lines have been observed for the first time. Tables of values of E/sub γ/ and I/sub γ/ are given. An energy level scheme of the ^{231}Th nucleus is constructed from the experimental data.

SPONTANEOUS AND INDUCED FISSION

56139 P-odd asymmetry in the fission of ^{233}U by polarized thermal neutrons. Vodennikov, B.D.; Danilyan, G.V.; Droyanov, V.P.; Novitskii, V.V.; Pavlov, V.S.; Borovlev, S.P. *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 1, 62-64(5 Jan 1978).

We measured the P-odd asymmetry of the emission of light (or, respectively, heavy) fragments along and against the orientation direction of the spins of the fissioning nuclei produced on capture of polarized thermal neutrons by ^{233}U. The asymmetry coefficient turned out to be a= (2.8 +- 0.3) x 10^{-4}. The positive sign means that the light fragments are emitted predominantly in the direction of the neutron-spin orientation.

56140 Search for unusual nuclei in fission products. Aleshin, V.I.; Bakalyarov, A.M.; Balysh, A.Y.; Borovoi, A.A.; Ketov, S.N.; Kopeikin, V.I.; Lebedev, V.I.; Mikaelyan, L.A.; Kheruvimov, A.N.; Shkol'nik, K.D. (I. V. Kurchatov Atomic Energy Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 483-485(Nov 1977).

A search is carried out for various rare events in spontaneous fission of ^{252}Cf: β electrons with unusually high energy, positron activity, and fission events with anomalously large prompt γ-ray energy. The existence of such phenomena could be related to the appearance of unusual nuclei, particularly superheavy nuclei, in the fission process. It is found that the relative probability of these events does not exceed (3—7) x 10^{-6}.

56141 Angular anisotropy and mass asymmetry of fragment pairs in neutron fission of ^{232}Th. Vorob'eva, V.G.; D'yachenko, N.P.; Mitrofanov, V.F.; Kuz'minov, B.D.; Sergachev, A.I.; Poenaru, D. (Physics and Power Engineering Institute, Obninsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 508-510(Nov 1977).

Measurements are reported of the angular anisotropy of fragments with fixed masses in fission of ^{232}Th by neutrons of energy 1.55, 1.7, and 3 MeV. It is found that the angular anisotropy of fragments with different masses is the same within experimental error over a wide range of masses: 125< or =M/sub H/< or =150. The angular anisotropy of fragment pairs symmetric in mass has been measured with an accuracy of +- 10% for a neutron energy of 3.0 MeV. Within the experimental error it coincides with the value for asymmetric fission modes.

56142 Effect of transition states of the fissioning nucleus ^{233}Th on fragment kinetic energy. D'yachenko, N.P.; Kuz'minov, B.D.; Mitrofanov, V.F.; Sergachev, A.I. (Physics and Power Engineering Institute, Obninsk). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 365-367(Oct 1977).

The dependence of the mean fragment kinetic energy on the energy of the neutrons producing fission of ^{232}Th nuclei has been investigated in the range from 1.2 to 2.3 MeV. The changes in fragment kinetic energy occur at the same neutron energies at which the fragment angular anisotropy changes. This agreement is considered as the manifestation of a relation between the variation of fragment kinetic energy and the quantum numbers of the transition states of the fissioning nucleus.

56143 Calculation of the average energy of β radiation from nuclear fission products. Aleksankin, V.G.; Kolobashkin, V.M.; Rubtsov, P.M.; Ruzhanskii, P.A. (Moscow Engineering-Physics Institute). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 403-405(Oct 1977).

Formula are presented for the calculation of the shape of the β spectra of allowed and unique transitions of first and second forbiddenness with inclusion of effects determined by the finite size of the nucleus and by electron screening. A procedure is described for calculation of the shape of the spectrum of parity-forbidden transitions of first and second order. For an extensive set of values of Z and endpoint energies E_0 we have obtained the ratio of the average energy E-bar to the endpoint energy E_0, $E/E_0 = f(E_0,Z)$. We have used the latest data on decay schemes to calculate the mean energies of the β particles emitted by nuclei with a complex decay scheme, which contribute the main part of the total energy dissipation of the mixture of fission products. The graphs and table presented can be used to evaluate effects due both to individual radionuclides and to their mixtures, and also in calculation of dosimetric characteristics of β-emitting sources.

NUCLEAR THEORY

NUCLEAR STRUCTURE

56144 Convergence of the hyperspherical expansion in the problem of three and four bodies and the properties of the interaction potentials. Demin, V.F. (I. V. Kurchatov Institute of Atomic Energy). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 379-384(Oct 1977).

The asymptotic properties of the hyperspherical expansion (HE) (in the limit $K\rightarrow\infty$) are determined in terms of "physical" basis functions for the problem of the bound state of three and four bodies as a function of the properties of "local" pair potentials of a general form (central + tensor + ls+p^2+xxx). It is shown that the HE in terms of "nonpotential" hyperspherical functions converges as a rule faster than that in terms of "potential" functions, so that the total convergence of the wave function and of the energy is determined by the latter only and it is identical for three and four particles. Certain recommendations are given with respect to the analytic properties of the potentials, these being directed towards the elimination of "nonphysical" numerical difficulties associated with the solution of the three- and four-body problems by various methods.

NUCLEAR MATTER

56145 Compressibility of nuclear matter. Gorbatov, A.M. (Kalinin State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 524-525(Nov 1977).

The behavior of the binding energy of a nucleus as a function of the nuclear density is investigated in the principal approximation of the method of hyperspherical functions with allowance for the hard core of the NN interaction.

NUCLEAR REACTIONS AND SCATTERING

56146 Lifetime of strongly excited nuclei. Baz', A.I. *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 2, 132-135(20 Jan 1978).

Coupled-channel theory is used to calculate the lifetime of an intermediate compound system having many decay channels. (AIP)

56147 Anisotropy with respect to the Yang-Treiman angle in quasielastic knockout of clusters from atomic nuclei by hadrons. Golovanova, N.F.; Ibraeva, E.T.; Neudachin, V.G. (Nuclear Physics Institute of the Moscow State University). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 1, 51-55(5 Jan 1978).

A new experimentally observable consequence of the allowance for "de-excitation" of clusters, namely anisotropy with respect to the Yang-Treiman angle (YTA), is predicted on the basis of the dynamic approach of Golovanova et al. [JETP Lett, 20, 310 (1974); 22, 50 (1975), Sov. J. Nucl. Phys. 23, 33 (1976), Nuclear Physics A262, 444 (1976)]. Certain conditions for the existence of the YTA are generalized. The degree of anisotropy depends on the range of values of the momentum p transferred to the cluster. Complete isotropy should always be observed in the region of maximum multiplicity of scattering of the hadrons by the cluster.

56148 Levinson's theorem and the scattering of nucleons by nuclei. Gubin, V.B.; Makhmud, M.K.; Neudachin, V.G. (Institute of Nuclear Physics, Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 532-534(Nov 1977).

The energy dependence of the scattering phases corresponding to Levinson's theorem in the scattering of nucleons by nuclei is given for the standard optical potentials. The values of the phases at zero, $\delta_l(0)$, change by steps as the nuclear shells are filled, and the total range of change of the phase can be broad, amounting to 4π, for example, for S scattering of neutrons by the nucleus ^{208}Pb. This situation is even more marked for the scattering of α particles by nuclei (example: α on ^{40}Ca).

56149 Cluster model of hadron interactions and the production of medium-energy nucleons on nuclei. Bogatskaya, N.G.; Eliseev, S.M.; Zinov'ev, G.M. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 535-536(Nov 1977).

The possibility of using the cluster model of hadron interactions to interpret high-energy hadron-nucleus scattering data is investigated. Special attention is given to the part played by medium-energy secondary nucleons (g particles) in the elucidation of the hadron-nucleus interaction mechanism.

56150 Four-nucleon problem in the integral-equation approach. Kharchenko, V.F.; Levashev, V.P. (Institute of Theoretical Physics, Academy of Sciences of the Ukrainian SSR). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 371-377(Oct 1977).

Integral equations of motion for a system of four pair-wise interacting nucleons are formulated assuming that the NN interaction is charge independent and is described by an arbitrary (local or nonlocal) exchange-type central potential. The equations are derived using the Faddeev-Yakubovskii method and taking the Pauli principle into account exactly. The obtained integral equations describe all possible reactions in the four-nucleon system with a two-body initial state (nucleon + three-nucleon nucleus or deuteron + deuteron), as well as four-nucleon systems in bound or resonant states.

56151 Single-nucleon absorption of slow pions by atomic nuclei and π condensation. Troitskii, M.A.; Koldaev, M.V.; Chekunaev, N.I. (I. V. Kurchatov Institute of Atomic Energy). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 662-669(Oct 1977).

The problem of the single-nucleon absorption of slow pions by atomic nuclei is solved. The presence of a pion condensate significantly increases the single-nucleon absorption probability. The measurement of the single-nucleon absorption probability may be a critical experiment for the elucidation of the question of the existence of a condensate in nuclear systems.

NUCLEAR MOMENTS AND SPIN

56152 Theory of rapid (nonadiabatic) rotation of nonspherical nuclei. Nosov, V.G.; Kamchatnov, A.M. (I. V. Kurchatov Atomic Energy Institute). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 3, 411-420(Sep 1977).

On the basis of the concept of the growing role of nonadiabatic effects of the nonconservation of the quantum number K a theory has been developed of the phenomenon which has been given the name of backbending. Above the transition point, for J> or =J/sub c/, all the values -J< or =K< or =J are equally probable. An investigation is made of the singularities possessed by the ordering parameter (proportional to the spectroscopic quadrupole moment of a nonspherical nucleus), the rotational angular velocity and the moment of inertia of a nucleus at the Curie point. Formulas have been derived for the intensity of quadrupole radiation in the more symmetric n-phase J>J/sub c/. By analyzing the experimental values of the moments of inertia belonging to the n-phase the radius of the mass distribution in the nucleus was determined. It agrees with the radius of the proton distribution derived from data on the scattering of electrons by nuclei. On the basis of the simplest form of the singularity of the parametric derivative of the Hamiltonian of the system a general theory of zero-temperature second-order phase transitions is developed in the Appendix.

NUCLEAR MODELS

56153 Statistical description of compound states of nuclei. Bunatyan, G.G. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 5, 518-523(Nov 1977).

A systematic development of the theory of finite Fermi systems for non-zero temperatures (Tnot =0) is undertaken on the basis of the method of temperature Green's functions. The properties of compound nuclear states are considered. The variations of the density matrix δrho, the self-energy part $\delta\Sigma$, the mean square radius $\delta\langle r^2\rangle$, the quadrupole moment $\delta\langle Q\rangle$, etc, are studied in a transition from the ground state (T=0) to an excited state with temperature T. The relationship connecting the excitation energy with temperature is obtained. Consistently taken into account is the strong interaction of the nucleons, in particular, the change in the one-particle nuclear potential as the temperature T is varied. Qualitative quasi-classical estimates are given for the effects considered, and the limits on the applicability of the statistical description of nuclei at large T are discussed.

56154 Thermodynamic functions of nuclei. Karamyan, S.A. (Joint Institute for Nuclear Research). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 390-393(Oct 1977).

Using the values of the nuclear temperature obtained earlier from reduction of experimental data on Γ/sub f//Γ/sub n/ ratios and lifetimes of compound nuclei, we calculate the following thermodynamic functions: thermodynamic temperature, characteristic temperature, specific entropy, and specific heat. The calculation is based on the thermodynamic equations of the Einstein and Debye models customarily employed to describe the heat capacity of solids. The spectral distribution of the nuclear excitation energy over frequency is calculated, and the classical limit of the nuclear heat capacity is determined.

56155 Simple microscopic model of giant resonances. Rumyantsev, B.A.; Telitsyn, V.B. (Nuclear Physics Institute, Siberian Division, USSR Academy of Sciences). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 393-396(Oct 1977).

We have investigated the relation between the particle-hole and hydrodynamic models of giant resonances in terms of the theory of finite Fermi systems. We propose a new approximation which allows analytical discussion and permits semiquantitative results to be obtained.

56156 Combined description of photonucleon spectra based on simultaneous use of the shell model and the pre-equilibrium-decay model. Zhivopistsev, F.A.; Ishkhanov, B.S.; Orlin, V.N.; Shvedunov, V.I. (Nuclear Physics Institute, Moscow State University). *Sov. J. Nucl. Phys. (Engl. Transl.);* **26**: No. 4, 397-403(Oct 1977).

We formulate a generalized model of giant-resonance decay which takes into account quasidirect, pre-equilibrium, and equilibrium mechanisms of photonucleon emission. Quasidirect emission of nucleons directly from a doorway dipole state is described by means of the shell model. Pre-equilibrium and equilibrium emission of nucleons is considered in terms of the pre-equilibrium-decay model. The predictions of the model are checked in the case of the ^{40}Ca nucleus.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 55052, 55472

MEDICAL PHYSICS

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

56157 (BNL-NCS—50681, pp 225-230) **Differential and integral neutron standards for high energy neutrons.** Wasson, O.A. (National Bureau of Standards, Washington, DC). Jul 1977.

From Symposium on neutron cross sections 10-40 MeV; Upton, NY, USA (3 May 1977).

In Symposium on neutron cross sections from 10 to 40 MeV.

There is need for standard neutron fields near 14 MeV for determination of standard cross sections. The availability of a standard neutron spectrum for calibration of various neutron flux monitors should provide a useful contribution to the standardization of neutron measurements. This paper describes the standard 14-MeV neutron fields available at the 3-MV Van de Graaff facility at the National Bureau of Standards. The facility uses the ^{3}H(^{2}H,n)^{4}He reactions. Aspects of measurements using the associated-particle technique are described including calibration of the proton recoil telescope, neutron flux monotor calibrations, and standard neutron-induced fission cross sections to be measured with the technique. 3 figures. (RWR)

56158 (LA—7288-T) **Calculation of dosimetry parameters for fast neutron radiotherapy.** Wells, A.H. (Los Alamos Scientific Lab., NM (USA)). May 1978. Contract W-7405-ENG-36. 416p. Dep. NTIS, MF A01.

Portions of document are illegible.

A computer simulation of the interactions of 50 MeV d^+ on Be and 42 MeV p^+ on Be neutron spectra with ICRU muscle tissue and Shonka A-150 tissue equivalent plastic was performed to allow computation of the charged particle spectra that result. Nuclear data were obtained from the Evaluated Nuclear Data File (ENDF) whenever possible and from the Intranuclear Cascade and Evaporation models otherwise. The dosimetry parameters calculated are: the kerma ratio, K/sub A-150//K/sub tissue/; the energy required to form an ion pair, W; and the stopping power ratio, S/sub g//sup W/ .

DOSIMETRY

REFER ALSO TO CITATION(S) 56158

56159 Nationwide evaluation of ^{60}Co teletherapy calibrations. Dicey, B.B.; Moe, H.J.; Tongue, T.M. (United States Nuclear Regulatory Commission, 799 Roosevelt Road, Glen Ellyn, Illinois 60137.). *Med. Phys.;* **5**: No. 5, 434-438(Sep 1978).

As a result of a reported incident which resulted in the unintended overexposure of several hundred patients, teletherapy installations throughout the United States were evaluated to verify the accuracy of teletherapy equipment calibrations. Selected licensees received TLDs for exposure under specified conditions. Site visits were made to each licensee showing an apparent discrepancy greater than +- 5% and intercomparison measurements made. This paper describes results of a sampling of 373 teletherapy licensees and the success of site visits in reducing final discrepancies to less than +- 5%. TLD and site visit measurement techniques, results, comparison with data from other studies, and possible sources of uncertainty in the management of a large-scale screening program are discussed.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 55468, 55479, 55482, 55960, 55997

56160 (COO—2679-23) **Problems with the observation of primary and secondary relaxations in grain boundaries by electron microscopy.** Balluffi, R.W.; Schindler, R. (Cornell Univ., Ithaca, NY (USA)). May 1978. Contract EY-76-S-02-2679. 12p. Dep. NTIS, PC A02/MF A01.

A review is given of various problems which arise in the study of primary and secondary relaxation structures in grain boundaries by transmission electron microscopy. These include: (1) the existence of weak relaxations which produces only exceedingly low contrast; (2) the existence of relaxations on a very fine scale which requires high resolution microscopy; (3) pseudo effects due to double diffraction; and (4) pseudo effects due to Moire fringes.

56161 Dynamic simulation of solution hardening. Schwarz, R.B.; Labusch, R. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *J. Appl. Phys.;* **49**: No. 10, 5174-5187(Oct 1978).

The flow stress for the motion of a dislocation through a random array of weak obstacles of finite interaction range, and in the presence of viscous forces, has been calculated by integrating numerically the equation of motion in a digital computer. Through a normalization of the coordinates and time it is shown that the normalized critical stress S is a function of only two parameters: a normalized obstacle depth eta_0 and a normalized viscous damping γ. Numerical values of S were obtained for stepwise changes in eta_0 and γ and for a set of boundary conditions compatible with real experiments. For $\gamma >$ or ≈ 3, S becomes independent of γ and of the initial conditions for the dislocation motion. The results reproduce the analytical dependences of the theories that have been developed for extreme values of eta_0, providing furthermore the proportionality constants and the extent of eta_0 for which these theories are applicable. For $\gamma < 3$, S is a function of eta_0 and γ and of the initial conditions for the dislocation motion: For a dislocation starting from rest there is an upper critical stress to initiate the motion, lower in value than S ($\gamma > 3$), while for a dislocation already in motion there is an even lower critical stress at which the dislocation stops moving. The latter corresponds to that calculated by the previous inertial theories, while the former had not been accounted for previously.

56162 Molecular dynamics of shock waves in one-dimensional chains. Holian, B.L.; Straub, G.K. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). *Phys. Rev., B;* **18**: No. 4, 1593-1608(15 Aug 1978).

The behavior of shock waves in one-dimensional chains has been explored in a series of molecular-dynamics computer experiments. Three "realistic" nearest-neighbor pair potentials were considered: Lennard-Jones 6-12, Toda, and Morse: as well as three truncated forms: harmonic, cubic, and quartic. Over a wide range of shock strengths the particle velocity profiles and shock speeds for a given form of potential can be characterized in strength by αv, where α is the cubic anharmonicity coefficient and v is the particle velocity in units of the long-wavelength sound speed. For strong shocks ($\alpha v > 1$), steady hard-rod-like velocity profiles are observed for the "realistic" potentials and the quartic truncated form, but not for the harmonic or cubic forms. The shock thickness in the harmonic chain grows as the cube root of time, while the shock thickness in the anharmonic chain grows linearly with time, in proportion to shock strength. This evolution of the shock thickness is unaffected by initial equilibration of the chain at finite temperature. If either a heavy- or light-mass defect is included, the shock wave is reflected and the relaxation process is slowed behind the defect.

56163 Spectral and spatial diffusion in a disordered system. Lyo, S.K.; Holstein, T.; Orbach, R. (Sandia Laboratories, Albuquerque, New Mexico 87115). *Phys. Rev., B;* **18**: No. 4, 1637-1640(15 Aug 1978).

Spectral and spatial diffusion in a three-dimensional inhomogeneously broadened system is studied for a two-site rate independent of the energy mismatch. The spectral diffusion is expressed in terms of spatial diffusion, and a Monte Carlo calculation is performed for the latter. The time-dependent behavior of the spectral profile is compared with the results of simple theoretical calculations.

56164 Quantum-chemical and lattice-defect hybrid approach to the calculation of defects in metals. Melius, C.F.; Bisson, C.L.; Wilson, W.D. (Sandia Laboratories, Livermore, California 94550). *Phys. Rev., B;* **18**: No. 4, 1647-1657(15 Aug 1978).

A hydrid theoretical approach is presented for the calculation of the properties of localized defects in solids. The method involves treating the electronic structure for the cluster of atoms immediately surrounding the defect from a quantum-mechanical point of view. Specifically, the Hartree-Fock method is employed here with appropriate pseudopotentials for the core electrons. The longer-range elastic distortions of the lattice are treated atomistically using two-body potentials and the lattice-defect method. The total energy of the system, including both the electronic energy of the cluster and the lattice-relaxation energy, is solved self-consistently. In this paper, the method is applied to a helium interstitial atom in fcc Ni. The hybrid calculations are compared with several two-body lattice-defect calculations as well as with quantum-chemical cluster calculations. The activation energy for diffusion along a $< 110 >$ direction is found to be 0.43 eV which is in reasonable agreement with the $\sim$ 0.34-eV experimental value of Thomas, Swansiger, and Baskes. The hybrid method eliminates the need to define a two-body interaction between the defect particle and the host atoms while incorporating both electronic redistribution and lattice distortion.

56165 Polariton standing-wave structure as a test of boundary conditions for theories of spatial dispersion. Johnson, D.L. (Ames Laboratory-ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010). *Phys. Rev., B;* **18**: No. 4, 1942-1947(15 Aug 1978).

The reflectivity of p-polarized light (E is in the plane of incidence) by a dielectric slab exhibiting spatial dispersion, when calculated theoretically in two limiting cases of internal specular reflection, has marked structure at frequencies corresponding to longitudinal polariton standing waves in the one case and transverse polariton standing waves in the other. This provides a possible experimental test of the approximate nature of the vacuum-crystal-vacuum polarizability and it also allows one to measure optically the polariton dispersion curve, either longitudinal or transverse. Application is made to the A (n = 1) exciton of CdS.

56166 Moment singularities at angular corners in liquid crystals of nematic type. Warren, W.E. (Sandia Labs., Albuquerque, NM). *Z. Angew. Math. Phys.;* **28**: 177-181(1977).

A linear theory of axial plane reorientation in liquid crystals of nematic type is utilized to examine principal moment singularities which may occur at the vertex of corner boundaries. Reorientation free, moment free, and mixed boundary conditions are considered, and the order of the singularity as a function of the corner angle for these three cases is obtained.

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 55462, 55511, 55515

56167 Josephson effect and collective excitations in thin-film superconducting bridges. Artemenko, S.N.; Volkov, A.F.; Zaitsev, A.V. (Institute of Radio Engineering and Electronics, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 2, 113-117(20 Jan 1978).

Weakly damped collective oscillations of the condensate velocity are discussed in the case of zero-gap superconductivity. (AIP)

56168 Nuclear spin relaxation in fine superconducting particles. Cheishvili, O.D. (Institute of Physics, Georgian Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 324-326(Aug 1977).

The density of states of electron excitations in fine superconducting particles is investigated on the basis of the thermodynamic fluctuation theory. In a narrow energy range near $\epsilon = \Delta_0$ the density is determined essentially by fluctuations of the order parameter. Nuclear spin relaxation is calculated over a broad temperature range by using the density of states thus found.

56169 Superconducting materials for large-scale applications. Dew-Hughes, D. (Brookhaven National Lab., Upton, NY). *Adv. Cryog. Eng.;* **22**: 316-325(1977).

Superconducting cable configurations are reviewed, and the properties of different superconducting materials are discussed. (GHT)

THEORETICAL PHYSICS

RELATIVITY AND GRAVITATION

56170 (NTIS/PS—78/0253) **Relativity theory (a bibliography with abstracts). Report for 1970—Feb 78.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Mar 1978. 178p.

Research studies are presented on special and general relativity. Gravitational theory, field theory, and space-time studies are included, as are studies involving the Minkowski space, the Schrodinger equations, the Dirac equations, and the Lorentz transformations. (This updated bibliography contains 173 abstracts, 15 of which are new entries to the previous edition.)

56171 General relativistic self-similar solutions with a spherical shock wave. Bogoyavlenskii, O.I. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 633-640(Oct 1977).

It is shown that the class of self-similar spherically symmetric solutions of Einstein's equations includes solutions with expanding and collapsing shock waves. The asymptotic behavior of these solutions and the topology of the spacelike sections are investigated. Attention is drawn to solutions with expanding shock waves in which the variation of the gas velocity after the passage of the shock wave has an oscillatory nature.

STATISTICAL PHYSICS AND THERMODYNAMICS

REFER ALSO TO CITATION(S) 55542

56172 Nucleation theory without Maxwell demons. Katz, J.L. (Inst. of Colloid and Surface Science, Potsdam, NY); Wiedersich, H. *J. Colloid Interface Sci.;* **61**: No. 2, 351-355(Sep 1977).

The equations for steady-state nucleation are derived from the rates of growth and decay of clusters with emphasis on a clear distinction between thermodynamic quantities and inherently kinetic quantities. It is shown that the emission rates of molecules from embryos can be related to the equilibrium size distribution of clusters in a saturated vapor. It is therefore not necessary to invoke the existence of an embryo size distribution constrained be in equilibrium with a supersaturated vapor. The driving force for nucleation is shown to be a kinetic quantity called the condensation rate ratio, i.e., the ratio of the rates of acquisition of molecules by clusters in the supersaturated vapor to that in a saturated vapor at the same temperature, and not a thermodynamic quantity known as the supersaturation, i.e., the ratio of the actual pressure to the equilibrium vapor pressure.

ELECTRICITY AND MAGNETISM

56173 (AD-A—048872) **The arbitrary body of revolution code (ABORC) for SGEMP/IEMP. Topical report, September 1975—June 1976.** Woods, A.J.; Delmer, T.N. (IRT Corp., San Diego, CA (USA)). 1 Jul 1976. Contract DNA001-75-C-0071. 138p. (INTEL-RT—8141-028). NTIS PC A07/MF A01.

The ABORC computer code for the solution of electromagnetic currents and fields around arbitrary bodies of revolution in SGEMP/IEMP problems is documented. Detailed descriptions of the physics and modeling used in the code are provided, and validation tests are discussed. Sample problems of interest in SGEMP, including results obtained for a wide range of object sizes and photon excitations, as well as geometry effects calculations, are explained. Considerations in choosing numerical grid sizes are outlined, and a complete user's manual is provided.

56174 (UCRL—81344) **Lawrence Livermore Laboratory data base for EMP external coupling-system relatability.** Bevensee, R.M.; Cabayan, H.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jul 1978. Contract W-7405-ENG-48. 37p. (CONF-780707—3). Dep. NTIS, MF A01.

From IEEE radiation effects conference; Albuquerque, NM, USA (18 Jul 1978).

Portions of document are illegible.

The external coupling data base prepared by Lawrence Livermore Laboratory for EMP assessment is described. The data may be used either by electromagnetic specialists or by engineers who may have only limited knowledge of the subject. Data generation by computer code and Transient Electromagnetics Range is described.

The modular (generic system) form of the base is outlined, with examples. The worst-case philosophy adapted is explained. Validation data for the Range are given. Illustrative simulation test data on a real system are compared to canonical and representative model data. The close agreement validates the links between the real system/canonical model and real system/representative model. Validation from other test data establishes the wide scope of the base for EMP prediction/estimation. 9 figures, 1 table.

MATHEMATICAL PHYSICS

56175 Super-convergent adiabatic invariants with resonant denominators by Lie transforms. McNamara, B. (Lawrence Livermore Laboratory, Livermore, California 94550). *J. Math. Phys. (N.Y.);* **19**: No. 10, 2154-2164(Oct 1978).

Adiabatic invariants of motion for perturbed Hamitonian systems are very important in plasma physics. It has been shown how to deal with resonant denominators to first order in the perturbation by judicious choice of the zeroth order invariant. The method is extended to higher orders by solving the Liouville equation and by using the Lie transform technique. The resulting invariants are shown to be equivalent by using the operator algebra of the averaging method involving the Poisson bracket, integrating, and averaging operations. Partial Lie transforms are introduced to describe the internal structure of any resonance in any order. The super convergent expansions of Kolmogorov are easily illustrated in the Lie formalism and allow a quick analysis of high-order resonances to be made.

56176 General expressions for divergence relations and multipole expansions for arbitrary scalar functions. Davies, K.T.R.; Becker, R.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Math. Phys. (N.Y.);* **19**: No. 10, 2207-2215(Oct 1978).

In theories of the cohesion of a system whose matter density is constant (e.g., classical liquid drops) or nearly constant except in a thin surface region (e.g., nuclei or neutron stars), there occur computationally difficult single and double volume integrals of energy densities. Such integrals have been important in recent dynamical calculations of fission and heavy-ion reactions. Even if the matter density is diffuse, the integrals can be written as integrals over finite volumes by modeling the density as the convolution of a step function and a diffuseness function. If the integrands can be written as divergences of tensor fields, the integrals over finite volumes can be reduced to surface integrals by Gauss' theorem. We have found general expressions, which we call divergence relations, for a vector field whose divergence is a given scalar function and for a second-rank tensor field whose double divergence is the scalar. The equations derived are much easier to use and apply to a wider class of functions than formulas previously obtained in the literature. The generalization to nth order for application to many-body forces is included, and for all orders the dimensionality is arbitrary. The interaction energy of two nonoverlapping systems is often most simply evaluated by using the generalized Slater multipole expansion of the two-body interaction. A new expression is derived for the radial factor G/sub l/(r_1,r_2) appearing in the multipole expansion of an arbitrary scalar, two-body function. This G/sub l/ is expressed as an integral involving the product of the Fourier transform of the interaction and two Bessel functions. For some cases this integral can easily be evaluated by contour integration.

FUSION ENERGY

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

56177 (AD-A—050885) **Preliminary study of high neutron flux fusion heating. Final report 1 May 77-3 Nov 77.** Liboff, R.L. (Cornell Univ., Ithaca, NY (USA). School of Electrical Engineering). 3 Nov 1977. 11p. NTIS PC A02/MF A01.

A heating scheme for nuclear fusion is proposed based on the availability of a high flux, low energy neutron source. The heat is derived in the reaction Li(6)(n,T)He(4) resulting from the incidence of a low energy neutron beam on a sample of Li(6)D. The energy release per reaction, Q = 4.6 MeV, is converted through a electron Coulomb collisions thereby quickly dissociating the solid sample to the plasma state. For about .001 eV neutrons it is estimated that this dissociation occurs in about 7 msec for an incident flux of 10 to the 17th power/sq. cm/sec. The possibility of further driving the heated fuel to fusion is also discussed.

56178 (GA-A—14881) **Lower hybrid wave heating in Doublet IIA.** Moeller, C.P.; Brooks, N.H.; Chan, V.S. (General Atomic Co., San Diego, CA (USA)). Feb 1978. Contract EY-76-C-03-0167-038. 6p. (CONF-780702—6). Dep. NTIS, PC A02/MF A01.

From Symposium on heating in toroidal plasmas; Grenoble, France (3 Jul 1978).

Doublet IIA electron heating experiments utilize lower hybrid waves launched by slow wave structures with various n/sub parallel/ = ck/sub parallel//ω (11, 14, 16) to achieve spatially localized heating by electron Landau damping. Radiofrequency power of 350 kW at 800 MHz and 200 kW at 915 MHz is available to heat circular discharges with ohmic input power of 100 kW. Significant increases in the electrical conductivity have been observed, but plasma response to the rf power is sensitive to the impurity level of the discharge. Power absorption mechanisms and energy balance will be discussed.

56179 (ORNL/TM—6434) **Tokamaks heated to high beta.** Dory, R.A.; Berger, D.P.; Charlton, L.A.; Hogan, J.T.; Munro, J.K.; Nelson, D.B.; Peng, Y.K.M.; Sigmar, D.J.; Strickler, D.J. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 46p.

Intense plasma heating (neutral beam, wave, alpha, ...) makes high energy density tokamaks possible. This paper treats the reaction of plasma which is heated to values of beta in the range of 5 to 15%.

56180 (PPPL—1395) **Parametric excitation of non-resonant ion cyclotron quasi-mode.** Ono, M.; Porkolab, M.; Chang, R.P.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Bell Labs., Murray Hill, NJ (USA)). Dec 1977. Contract EY-76-C-02-3073. 14p. Dep. NTIS, PC A02/MF A01.

Parametric excitation of non-resonant ion cyclotron quasi-mode in a low density (i.e., ω/sub pi/ equal to or approximately ω/sub ci/) plasma is observed when the pump frequency is ω_0 > or approximately 2ω/sub ci/. The ion heating associated with the decay is also observed. Such processes may take place near the plasma surface during ICRF heating experiments in tokamaks.

56181 (PPPL—1436) **Recent results from the PLT tokamak.** Arunasalam, V.; Barnes, C.; Bol, K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1978. Contract EY-76-C-02-3073. 30p. (CONF-770906—11). Dep. NTIS, PC A03/MF A01.

From 8. European conference on controlled fusion and plasma physics; Prague, Czechoslovakia (19 Sep 1977).

Impurity behavior is discussed, specifically the control of oxygen by discharge cleaning and the identification and quantitative measurement of tungsten radiation. The main types of PLT discharges are compared, classified by tungsten content and MHD instability properties. Plasma confinement is then discussed.

56182 (PPPL—1460) **Parametric lower-hybrid instability driven by modulated electron beam injection.** Allen, G.R.; Owens, D.K.; Seiler, S.W.; Yamada, M.; Ikezi, H.; Porkolab, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1978. Contract EY-76-C-02-3073. 15p. Dep. NTIS, PC A02/MF A01.

A modulated electron beam is injected into a low β plasma parallel to the confining field to investigate the energy-transfer-rate from the electron beam to the plasma. Parametric excitation of electrostatic lower-hybrid waves and ion cyclotron quasimodes is experimentally identified. The temperature of both ions and electrons is observed to increase significantly concomitant with the growth of the instability.

56183 (UCRL—80636) **Studies of tandem mirror confinement.** Baldwin, D.E.; Cohen, R.H.; Foote, J.H.; Hall, L.S.; Kaiser, T.B.; Logan, B.G.; Pearlstein, L.D.; Rognlien, T.D.; Kesner, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jul 1978. Contract W-7405-ENG-48. 10p. (CONF-780811—3). Dep. NTIS, PC A02/MF A01.

From 7. conference on plasma physics and control; Innsbruck, Austria (23 Aug 1978).

This paper describes a number of physics studies relevant to tandem mirror confinement. We give the basic axial confinement laws and show that T/sub e/ depends critically upon end loss. Sufficient central-cell end loss can stabilize the drift-cyclotron loss-cone mode in the plugs, although the resultant T/sub e/ scaling is too slow for reactors. Minimum-B plugs stabilize flute MHD- and rotation-driven modes; local ballooning sets limits on β > or equal to 0.5. Proper magnetic symmetry is important for good drift confinement. For small increases in the total injected power, supplementary ion-cyclotron r.f. heating can halve the neutral-beam energy required to maintain plug densities.

56184 Unstable behavior of hot, magnetized plasma in contact with a cold wall. Lindemuth, I.R.; Pettibone, J.S.; Stevens, J.C.; Harding, R.C.; Kraybill, D.M.; Suter, L.J. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Fluids;* **21**: No. 10, 1723-1734(Oct 1978).

The behavior of a hot, magnetized plasma brought into contact with a cold wall is studied numerically in one and two dimensions. A fully nonlinear, time-dependent magnetohydrodynamic plasma model which includes thermal conduction, resistive diffusion, radiation, and ionization is used. The model is solved numerically with an Eulerian computer code which employs implicit finite difference methods. One-dimensional calculations for cylindrical geometry examine the effect of the electrical properties of the wall on the plasma. Two-dimensional calculations for cylindrical geometry show the formation of a wall-induced instability which enhances thermal conduction losses from the plasma; the re-emergence of short wavelengths, a new feature of unstable behavior, is evident in the calculations. Two-dimensional calculations for toroidal geometry show that heat losses to a cold wall lead to double-vortex convection flow of the plasma with no evidence of the formation of smaller scale convective cells.

56185 Stabilization of torodial currents in high-β plasmas by surface magnetic fields. Mamas, D.L.; Schumacher, R.W.; Wong, A.Y.; Breun, R.A. (Department of Physics, University of California, Los Angeles, California 90024). *Phys. Rev. Lett.;* **41**: No. 1, 29-33(3 Jul 1978).

Without the imposition of a toroidal magnetic field, a toroidal plasma current is sustained whose maximum current density increases linearly with the applied poloidal surface magnetic field strength. Both plasma compression and heating are observed in the main weak-field region, and average $\beta \simeq 6\%$ and energy confinement time tau = 1 msec have been achieved. This concept significantly increases the β values and the allowable current in toroidal, Ohmically heating plasmas.

56186 Condition for absolute confinement of alpha particles in helical tokamaks. Ikuta, K. (NAGOYA UNIV. (JAPAN). INST. OF PLASMA PHYSICS); GIMBLETT, C.G. (EURATOM/UKAEA FUSION ASSOCIATION, ABINGDON (UK). CULHAM LAB.). *Nucl. Fusion;* **18**: No. 4, 451-456(1978).

The criterion for absolute confinement of alpha particles in helically symmetric magnetic field configurations is established. In particular, a helically deformed tokamak configuration is investigated. The helical deformation of the magnetic surfaces can significantly increase the value of the product aB_0 required for absolute confinement of alpha particles, where a is the characteristic plasma cross-section in metres and B_0 is the characteristic field strength in teslas.

56187 Features of x-ray spectra of a plasma produced by a subnanosecond laser pulse. Aglitskii, E.V.; Zherikhin, A.N.; Kryukov, P.G.; Chekalin, S.V. (Spectroscopy Institute, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 707-711(Oct 1977).

We investigate the x-ray spectra of multiply-charged ions produced when a plasma is heated by laser pulses of 250 psec duration and 5 J energy. Besides the lines formed by high-multiplicity ions, transition lines of ions of comparatively low multiplicity were recorded, although the plasma-electron temperature reached 1 keV and the electron density reached a value on the order of 10^{21} cm^{-3}. The presence of low-multiplicity ion lines can be attributed to the nonstationary character of the ionization process when the plasma is heated by a subnanosecond pulse since conditions are then produced in the plasma under which the pulse duration is sufficient for the electrons to heat up quickly but the ions cannot reach the ionization state corresponding to the given electron temperature. These conditions must be produced in the plasma to obtain population inversion in the far-vacuum ultraviolet and soft x-ray regions. The plasma-electron temperature and density were determined from the obtained spectra under the assumption that plasma heating was nonstationary.

56188 Experimental investigation of the mechanism of turbulent heating of a plasma carrying a transverse current. Virko, V.F.; Kirichenko, G.S. (Nuclear Research Institute of the Ukrainian Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 264-269(Aug 1977).

A stationary model of a plasma with a transverse current was realized in a system consisting of an electron-ionized ion beam moving perpendicular to a magnetic field. It is established that the produced turbulence is due to excitation of ion-sound oscillations that propagate across the magnetic field. The oscillations are unstable in a wide wavelength range bounded from below by the average Larmor radius of the electrons. The characteristics of the instability are investigated in the saturation regime. It is established that effective linear transformation of the noise spectrum takes place in the direction towards decreasing frequencies (wave numbers). The structure of the wave process in k-space is experimentally investigated, and it is established that the excited oscillations are three dimensional and that their phase correlation is disturbed. At large wave numbers, the steady-state nonlinear spectrum is characterized by an exponential decrease of the noise amplitude with increasing k. In the case of advanced instability, the ions and electrons are found to be heated. The final state of the plasma is characterized by a relation T/sub i/ < or ≈T/sub e/ between the ion and electron thermal energies, owing to the rapid heating of the ions as a result of capture by the ion-sound waves.

56189 Ion heating on high-current electron beam interaction with a plasma and capture of a part of the beam into a mirror magnetic trap. Kolyada, YU.E.; KORNILOV, E.A.; FAINBERG, YA.B.; KIYASHKO, V.A. *Zh. Tekh. Fiz.;* **47**: No. 1, 83-92(Jan 1977). (In Russian).

Experimental study is given on ion heating during electron high-current beam interaction with a plasma and trapping of some part by a mirror-type magnetic trap. As the beam passes through plasma, powerful high-frequency oscillations excited in the latter and also a wide spectrum of low-frequency oscillations in the region of a lower hybrid resonance-ion plasma frequency, result in plasma ion heating. Part of the beam particles is trapped thus leading to the appearance of a space charge. Upon completion of beam injection into the trap the presence of the space charge in the plasma causes further heating of the ions and their confinement in the mirrortype magnetic trap. An electron beam was used at 100-150 keV and 7-12 kA with the pulse duration between 0.7 and 1.0 μs, formed by a plasma linear betatron. The plasma ion temperature up to 500 eV at a density of 5×10^{12} cm^{-3} was obtained.

56190 Stabilization of an explosive instability and heating of plasma ions by a modulated particle flux. Fainshtein, S.M. (GOR'KOVSKIJ POLITEKHNICHESKIJ INST. (USSR)). *Zh. Eksp. Teor. Fiz.;* **71**: No. 9, 1021-1024(Sep 1976). (In Russian).

The problem of explosive instability in a nonisothermal plasma penetrated by a mono-velocity charged particle flux is considered. The possibility is investigated of stabilizing the instability by transforming the h.f. wave energy into energy of nonlinear ion-sound waves, this being equivalent to nonlinear absorption of the h.f. waves. Estimates are presented which show that heating of heavy particles (ions) by a charged particle beam should be effective.

56191 Heating of plasma electrons while collective interaction of an electron beam with an inhomogeneous plasma. Berezina, G.P. (AN UKRAINSKOJ SSR, KHARKOV. FIZIKO-TEKHNICHESKIJ INST.). *Fiz. Plazmy;* **1**: No. 6, 979-981(1975). (In Russian).

Interaction of an electron beam with an inhomogeneous plasma is studied. Experiments have shown that on beam injection in the direction of reducing plasma density there was observable heating of plasma electrons at the end of the chamber. The ratio of longitudinal and transverse electron temperatures at the end and at the beginning of the interaction range increases with the growing plasma electron density gradient. The experimental results are in qualitative agreement with theory.

56192 Propagation of plane supersonic radiation waves. Bergel'son, V.I.; LOSEVA, T.V.; NEMCHINOV, I.V.; ORLOVA, T.I. (AN SSSR, MOSCOW. INST. FIZIKI ZEMLI). *Fiz. Plazmy;* **1**: No. 6, 912-922(1975). (In Russian).

The paper discusses the possibility of production of a laser plasma whose density would be close to a constant value with a uniform time-independent temperature distribution in a plane geometry. Determination is given to parameters of the air behind the plane plasma front propagating with a high speed in the direction of the laser radiation flux owing to the processes of emission and absorption of continuous spectrum radiation. The lower limit of the existence of such supersonic radiation waves for the emission of a neodymium laser is evaluated. The results of the numerical calculation of the radiation-gasodynamic problem are compared with a simplified model of the quasistationary stage of the phenomenon under study, and qualitative explanation is submitted for the relations obtained with respect to variation of the flux density wavelength of the laser radiation.

56193 High-frequency electric field plasma heating. Musher, S.L.; RUBENCHIK, A.M. (AN SSSR, NOVOSIBIRSK. INST. AVTOMATIKI I EHLEKTROMETRII). *Fiz. Plazmy;* **1**: No. 6, 982-989(1975). (In Russian).

An excitation is studied of langmuir oscillations with an electromagnetic wave whose frequency is close to that of plasma. Account is taken of decay instabilities of the first and the second order. Consideration is given to the following two processes: conversion of the electromagnetic wave into langmuir ion oscillations and decay of the electromagnetic wave into langmuir and virtual ion-acoustic oscillations. For the turbulence description are introduced "anomalous" correlation functions. Represented graphically are flows of energy into the plasma owing to the decay instabilities of the first and the second order at the threshold.

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 56302

56194 (BNL—50825) **Preliminary measurements of plasma density.** Keane, J.T. (Brookhaven National Lab., Upton, NY (USA)). 11 Apr 1978. Contract EY-76-C-02-0016. 10p. Dep. NTIS, PC A02/MF A01.

The phase velocity of a microwave signal propagating in a plasma is increased providing that its frequency is much higher than the plasma frequency. It follows that by forming a resonator around the plasma and noting the resonant frequency shift plasma frequency and thus plasma density may be measured. To check the feasibility of this type of measurement, a section of vacuum pipe in the HIF beam transport line was resonated and the frequency shift resulting when beam was turned on was noted.

56195 (COO—4001-6) **Quantitative measurements in laser induced plasmas using optical probing. Progress report, October 1, 1977—April 30, 1978.** Sweeney, D.W. (Purdue Univ., Lafayette, IN (USA). School of Mechanical Engineering). Jun 1978. Contract EY-76-S-02-4001. 44p. Dep. NTIS, PC A03/MF A01.

Optical probing of laser induced plasmas can be used to quantitatively reconstruct electron number densities and magnetic fields. Numerical techniques for extracting quantitative information from the experimental data are described and four Abel inversion codes are provided. A computer simulation of optical probing is used to determine the quantitative information that can be reasonably extracted from real experimental systems. Examples of reconstructed electron number densities from interferograms of laser plasmas show steepened electron distributions.

56196 (LA-UR—78-1436) **Proximity-focus: the new generation streak tube.** Lieber, A. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 8p. (CONF-780804—2). Dep. NTIS, PC A02/MF A01.

From 13. congress on high-speed photography and photonics; Tokyo, Japan (20 Aug 1978).

A new era in x-ray and visible streak photography opened with the introduction of the proximity-focus or planar streak tube. Elimination of grids and photoelectron pinhole optics has resulted in a tube capable of transmitting peak photoelectron currents necessary for recording picosecond and sub-picosecond events without temporal or spatial distortion. Vacuum compatible x-ray cameras, based upon the planar design, have demonstrated better than 3 ps resolutin. Visible cameras have shown impressive dynamic range and produced streaks of high statistical quality with picosecond resolution. These properties have opened new fields in picosecond and sub-picosecond photography.

56197 (PPPL—1457) **Determination of Fe charge-state distributions in PLT by Bragg crystal x-ray spectroscopy.** Hill, K.W.; von Goeler, S.; Bitter, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1978. Contract EY-76-C-02-3073. 40p. Dep. NTIS, PC A03/MF A01.

A curved-crystal Bragg x-ray spectrometer has been used to measure Kα or 1s-2p radiation from highly stripped Fe XVIII to Fe XXV impurity ions in the PLT tokamak. The spectrometer has sufficient energy resolution (approximately < 4 eV at 6400 eV) to distinguish between the different ionization states of iron by measuring the energy shift of the Kα x rays. The measured wavelengths agree well with theory and with spectra from solar flares and from laser-produced plasmas. The distribution of Fe charge states in the center of the discharge has been inferred from a comparison of the measured x-ray spectrum with theory. The shape of the spectrum depends strongly on electron temperature (T/sub e/) in the range T/sub e/ = 800 to 1500 eV. Within the factor of two uncertainty in L-shell ionization cross sections, measured intensities agree with theory, which is based on coronal equilibrium, indicating that the ion life-time in the center of the plasma is approximately equal to or greater than the equilibration time.

56198 (PPPL—1465) **Obeservation of a forbidden line of FeXX and its application for ion temperature measurements in the PLT tokamak.** Suckewer, S.; Hinnov, E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1978. Contract EY-76-C-02-3073. 13p. Dep. NTIS, PC A02/MF A01.

A spectrum line in the PLT tokamak discharges, with wavelength measured as 2665.1 +- 0.3A, has been identified as the $2s^2 2p^3$ ^{2}D/sub 5/2/ → ^{2}D/sub 3/2/ magnetic dipole transition in the FeXX ground configuration. A variety of localized spectroscopic diagnostics, e.g., ion temperature and density distribution measurements in the high-temperature interior of the plasma, are feasible by means of forbidden lines of this type. The 2665A line has been used to measure near-central ion temperature in a discharge with auxiliary neutral beam heating.

56199 (UCID—17806) **Multichannel magnetic analyzer for pulsed plasma sources.** Osher, J.E.; Stroh, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 May 1978. 15p. Dep. NTIS, PC A02/MF A01.

We constructed, calibrated, and used a simple multichannel magnetic analyzer for pulsed plasma-target production studies. With time-of-flight resolution of velocity, the channel signals unfolded to yield a measurement of each of the present ion-energy-distribution functions. Measurements made with a narrow-slit, high-gain electron multiplier detector allowed clearly resolved identification of each major ion species. However, because of the uncertainty of secondary-emission detection efficiency for high-q ions, we made all absolute signal measurements with a wider entrance slit and an array of Faraday-cup detectors. The latter arrangement was calibrated with an H^+ beam of known adjustable energy. We describe how this instrument can determine N^+ to N^{7+} and H^+ ion-distribution functions for a CO_2 laser pulse incident on an NH_3 pellet.

56200 (UCRL—80781) **Regenerative amplifier: a source for synchronized, variable-duration pulses.** Murray, J.E.; Lowdermilk, W.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1978. Contract W-7405-ENG-48. 5p. (CONF-780579—3). Dep. NTIS, PC A02/MF A01.

From Meeting on picosecond phenomena; Hilton Head, SC, USA (24 May 1978).

Regenerative amplifiers (RA) are flexible and stable devices for amplifying and varying the pulsewidth of picosecond pulses. With a Nd : YAG-RA amplifications up to 14 orders of magnitude with a stability of +-2% have been demonstrated. Also, variable pulsewidths over the range 10^{-11} to 10^{-9} sec for a fixed injection pulsewidth were demonstrated. With these capabilities, the RA can be used in a dual-pulse system to provide stable, accurately synchronized pulses of widely different duration. Such a system greatly extends the range of pulse-probe experiments for studies of relaxation phenomena, photochemistry, and laser-generated plasmas.

56201 (UCRL—81303) **Description of a projector for viewing ulra-high-speed rotating mirror camera records in a cinematographic mode.** Honodel, C.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jun 1978. Contract W-7405-ENG-48. 5p. (CONF-780804—6). Dep. NTIS, PC A02/MF A01.

From 13. congress on high-speed photography and photonics; Tokyo, Japan (20 Aug 1978).

The photographic records produced by most ultra-high-speed rotating mirror framing cameras contain images which are non-standard size and non-uniformly positioned on 35 mm filmstrips. Timing and qualitative information is normally extracted from these records by mounting them in filmstrip projectors. The important, precise quantitative data are extracted by individual framing digitization. In an attempt to enhance the visual qualitative movements contained in these records, we recently completed a model of a "Cine-Mode Projector" which accepts the 35 mm filmstrips and provides, in a cinematographic mode, a position-corrected display on a rear-projection screen. The framing rate, including single-step, as well as forward and reverse, is selectable by the viewer.

56202 **Pulsed electrostatic probes as a diagnostic for transient plasmas.** Schoenberg, K.F. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Rev. Sci. Instrum.;* **49**: No. 10, 1377-1383(Oct 1978).

A pulsed, electrostatic probe data acquisition system, applicable to transient or noisy plasmas, is presented. The system digitally records a probe characteristic, and its first and second derivatives. The latter are shown to be proportional to the projected electron energy distribution function, and the isotropic electron energy distribution function, respectively. The acquisition system and its experimental accuracy are discussed. Using the Lawrence Berkeley Laboratory 10-A neutral beam ion source, several examples demonstrating the systems application to transient plasmas are given.

56203 **Thomson parabola ion analyzer for laser-plasma studies.** Slater, D.C. (KMS Fusion, Inc., Ann Arbor, Michigan). *Rev. Sci. Instrum.;* **49**: No. 10, 1493-1494(Oct 1978).

A compact, flexible design for a parallel-fields ion analyzer is presented. Accurate ion velocity and charge state measurements can be obtained over a wide range without the need for calibration sources. Etchable cellulose-nitrate foil is used to record individual ion tracks.

56204 **Intensities of resonance line satellites of helium-like ions with Z=12—23 in laser plasma x-ray emission.** Boiko, V.A.; Pikuz, S.A.; Faenov, A.Y. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 2, 226-231(Feb 1978).

A detailed comparison was made between the experimental and theoretical relative intensities of the satellites to check the calculations of the probabilities of radiative decay A/sub s/ and autoionization Γ/sub s/ of doubly excited states, and of the ratio between the rates of excitation of an electron from the K shell of a lithium-like ion and of the resonance line C/sup k//sub s//C/sub R/. This analysis of the intensities of the resonance line satellites of multiply charged helium-like ions with Z=12—23 showed good

agreement between theory and experiment. From this it was concluded that the calculations of the decay probabilities and excitation cross sections of the autoionized levels were reliable and could be used to develop diagnostic techniques for dense high-temperature laser plasmas.

56205 Plasma diagnostics based on coherent four-photon scattering of light by ionic sound. Bunkin, F.V.; Kalinin, F.V.; Pashinin, P.P. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 2, 278-279(Feb 1978).

A theoretical proposal is made of a method for diagnostics of a low-temperature plasma. This method is based on coherent four-photon scattering of light and its advantage over the usual Thomson scattering is the enormous enhancement of the scattering signal, which depends on the intensities of the pump beams. The method can be used to determine the electron density, damping coefficient of ionic sound, and electron temperature of a plasma.

56206 X-ray line emission by a superdense plasma. Vinogradov, A.V.; Skobelev, I.Y. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 2, 88-91(20 Jan 1978).

In connection with development of inertial systems for plasma heating (Proceedings of the Sixth International Conference on Plasma Physics and Controlled Nuclear Research, Berchtesgaden, 6—13 October 1976; Proceedings of International Conference on the Technology of Inertially Confining Systems, Dubna, 19—23 July 1976), a new method is proposed for the diagnostics of a hot plasma with electron density N/sub e/> or $\approx 10^{22}$ cm^{-3}, by using the relative intensities of the x-ray lines of multiply charged ions.

56207 Probe measurements of the temperature and space potential in a magnetic field. Kuteev, B.V.; Rozhanskii, V.A. (Leningrad Polytechnical Institute). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 1, 49-50(Jan 1978).

Measurements of the electron and ion saturation currents in a helium afterglow were made and compared to theoretical predictions.

56208 Determination of plasma temperature from cyclotron absorption in an inhomogeneous magnetic field. Skovoroda, A.S.; Timofeev, A.V.; Shvilkin, B.N. (Moscow State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 275-280(Aug 1977).

Cyclotron oscillations accompanying nonmonotonic variation of the magnetic field in a region occupied by a plasma are considered. It is shown that at a frequency somewhat lower than the minimal cyclotron frequency (or higher than the maximal one) the oscillation absorption coefficient depends strongly on the plasma temperature. This uncovers a possibility of determining the plasma temperature by measuring the absorption coefficient. The proposed procedure was tested on the simplest plasma object, a gas-discharge plasma. The results agree well with data obtained by the probe method. It is assumed by the authors that the proposed method of determining the plasma temperature can be used also in thermonuclear systems.

56209 Local changes of electron energy spectra in a plasma. Altuntsev, A.T.; KRASOV, V.I. (AN SSSR, IRKUTSK. SIBIRSKIJ INST. ZEMNOGO MAGNETIZMA IONOSFERY I RASPROSTRANENIYA RADIOVOLN). *Zh. Tekh. Fiz.;* **47**: No. 1, 44-49(Jan 1977). (In Russian).

A method is described suitable for the measurement of the local electron energy spectrum according to bremsstrahlung from a target placed in a plasma volume. The spatial resolution is dependent on target dimensions. Measurement results are presented for the electron energy spectrum in a non-collisional plasma neutral layer produced in a THETA-pinch-type device with cusped magnetic fields. Effective plasma heating is localized in the region of the zero magnetic field line. The radiation spectrum analysis was performed by the absorbent method, use being made of films having various thicknesses and made of various substances. Used as radiation detector were plastic scintillators. The electron energy spectrum differs from the maxwellian one by a higher content of electrons with energies over 10Tsub(e). The results obtained confirm the conclusion as to the development of small-scale turbulence in the layer.

56210 To the problem of statistically-inhomogeneous plasma diagnostics with the help of refraction. Bezrodnii, V.G.; DUSHIN, L.A.; SERIKOV, A.V. *Zh. Tekh. Fiz.;* **47**: No. 1, 56-63(Jan 1977). (In Russian).

Consideration is given to the effect of plane-laminated statistical inhomogeneities of a medium on refraction of an electromagnetic wave therein. It is shown that pulsations of the ray emergence point are governed by the pulsations of the turning point in the medium when the gradients of the accidental component of the refraction index exceed the mean gradient being conditioned by regular refraction. The possibility is discussed of using the results obtained for diagnostics of a statistically inhomogeneous nongyrotropic plasma.

56211 Laser-plasma microwave measurements. Chernyshev, L.E. (AN SSSR, MOSCOW. FIZICHESKIJ INST.). *Zh. Tekh. Fiz.;* **47**: No. 1, 76-82(Jan 1977). (In Russian).

The local measurements of electron density distribution in a volume of a spreading laser-produced plasma have provided a means to represent spatial profiles of electron density at different times. The spatial profiles are shown to be markedly dependent on the shape of the laser pulse in time. Interferometry of the laser-produced plasma was performed by the Mach-Zehnder method. The plasma was produced by focusing radiation of a multi-mode neodymium laser onto an aluminum target. HF radiation of a klystron oscillator with a wavelength of 11 mm was branched into two channels: reference and measuring. The phase oscillation difference in the channels was conditioned by the plasma during its flight in a 4-cm gap between two funnel-type antennae. The passed-through and plasma-reflected signals were measured.

56212 Measurement of electron distribution function by means of direct differentiation of probe characteristic. Glosik, J.; JASEM, P. (KARLOVA UNIVERSITA, PRAGUE (CZECHOSLOVAKIA). FAKULTA MATEMATICKO-FYZIKALNI). *Czech. J. Phys.;* **27**: No. 8, 899-903(1977).

Measurements of the second derivative of the probe characteristic using derivation amplifiers are reported. Experimental technique of measuring the probe characteristic in time intervals of several μs duration as well as a method used for testing the accuracy in the determination of the second derivative are described.

PLASMA KINETICS - GENERAL

56213 Ion beam-plasma wave modes and ion beam deceleration by ion-acoustic turbulence. D'Angelo, N.; HERINK, K.; REINLEITNER, L. (IOWA UNIV., IOWA CITY (USA). DEPT. OF PHYSICS AND ASTRONOMY). *Phys. Lett., A;* **65**: No. 3, 231-232(6 Mar 1978).

The properties of ion beam-plasma wave modes have been utilized to diagnose the ion beam deceleration by ion-acoustic turbulence in a multidipole plasma device.

PLASMA KINETICS - EXPERIMENTAL

56214 Resonances in 1s-2s and 1s-2p collision strengths for electron impact excitation of hydrogenic ions. Hayes, M.A.; SEATON, M.J. (UNIVERSITY COLL., LONDON (UK). DEPT. OF PHYSICS). *J. Phys., B (London);* **11**: No. 3, L79-L82(14 Feb 1978).

Accurate rate coefficients for the electron impact excitation of positive ions are required for the interpretation of the spectra of hot plasmas. In making calculations, account should be taken of resonances in collision strengths at energies which contribute to the rate coefficients. For 1s-2s and 1s-2p excitation of hydrogenic ions it is shown that (3l3l′) resonances occur at energies close to the excitation thresholds. The effect of resonances of the type (3ln′l′) with n′ >- 3 is to increase rate coefficients by about 20% for 1s-2s and 10% for 1s-2p.

56215 Influence of collisions between laser plasma jets in conical targets on the plasma parameters in the final stages of expansion. Bykovskii, Y.A.; Kozyrev, Y.P.; Kozlovskii, K.I.; Tsybin, A.S. (Engineering-Physics Institute, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.);* **8**: No. 2, 195-198(Feb 1978).

An investigation was made of the charge, kinetic, and geometric parameters of the ion component of a laser plasma in the final stages of expansion when the radiation was focused into a conical recess in a lead target. The dependences of these parameters on the cone vertex angle were determined and a comparison was made with plane targets. The measurements were made by probe and mass spectrometer techniques. The results suggest that a narrow highly directional plasma jet with a high degree of ionization can be produced by optimizing the target shape and the radiation focusing conditions. A possible mechanism of the influence of collision processes on the resultant plasma parameters is discussed.

56216 Role of arcing in producing metal impurities in tokamaks. McCracken, G.M.; GOODALL, D.H.J. (EURATOM/UKAEA FUSION ASSOCIATION, ABINGDON (UK). CULHAM LAB.). *Nucl. Fusion;* **18**: No. 4, 537-543(1978).

Measurements have been made of the number of metal atoms deposited on collectors during tokamak discharges in DITE. The amount of metal is shown to be larger than that expected due to sputtering by hydrogen ions and charge-exchange neutrals. It is proposed that arcing is responsible for this metal deposition and direct observation of arc tracks on limiters and probes is described.

56217 Interaction of a relativistic electron beam with a dense plasma. Kiselev, V.A.; BEREZIN, A.K.; FAINBERG, YA.B. (AN

UKRAINSKOJ SSR, KHARKOV. FIZIKO-TEKHNICHESKIJ INST.). *Zh. Eksp. Teor. Fiz.;* **71**: No. 1, 193-202(Jul 1976). (In Russian).

Results are presented of an experimental investigation of the efficiency of interaction between a monoenergetic relativistic electron beam and a dense plasma (nsub(p) approximately 10^{15}-10^{17} cm^{-3}). It is shown that the efficiency of interaction between a monoenergetic, low-divergence beam and a plasma does not decrease with growth of plasma density. Localized electromagnetic radiation from the interaction region with a wave-length lambda approximately 1 mm and soft localized X-ray radiation are observed. A spatial correlation is found between the region of production of the X-ray and uhf radiations and of the decrease of the plasma density.

56218 Electron thermal conduction in Tokamaks. Kadomtsev, B.B. (GOSUDARSTVENNYJ KOMITET PO ISPOL'ZOVANIYU ATOMNOJ EHNERGII SSSR, MOSCOW. INST. ATOMNOJ EHNERGII). *Fiz. Plazmy;* **1**: No. 6, 938-943(1975). (In Russian).

Qualitative examination is performed with respect to a possible reason for the enhanced electron heat conductivity based on the assumption of the presence of minor disturbances in the axial symmetry of a plasma column. Experimental data demonstrate that this mechanism results in the so called pseudoclassical heat conductivity at an electron high temperature and in the Bohm type heat transfer at a reduced temperature. It is suggested that the present-day tokamaks operate, to a certain extent, in the same Bohm region that turned out to be unfavourable for stellarators. However even in this region tokamaks show better confinement behaviour, which can be attributed to the lower values of R/a (R is the torus radius, a is the plasma column radius). Both the pseudoclassical dependence and the Bohm dependence are explained by the presence of temperature disturbances, the appearance of these disturbances being due to the upsetting of an azimuthal symmetry.

56219 SHF radiation of plasma and acceleration regime of a discharge in the Tokamak FT-1. Larionov, M.M.; LEVIN, L.S.; ROZHDESTVENSKII, V.V.; TOKUNOV, A.I. (AN SSSR, LENINGRAD. FIZIKO-TEKHNICHESKIJ INST.). *Fiz. Plazmy;* **1**: No. 6, 923-930(1975). (In Russian).

It is studied the frequency spectrum of SHF radiation, hard X-radiation, diamagnetism, conductivity and density of plasma in high-temperature and accelerating regimes of the FT-1 tokamak. It is shown that the intensities of hard X-radiation and SHF radiation in an accelerating discharge are far more than in a high-temperature discharge. In the first case radiation temperature of the SHF range reaches 7 keV while in the second one it will be 7 eV. The difference in the radiations points to the diverse role of electron running-away. The total and transverse energies of run-away electrons are evaluated according to the X-ray energy and SHF radiation. The transverse energy of the run-away electrons is found to be 80 keV. This value permits interpretation of the observed plasma diamagnetism.

PLASMA KINETICS - THEORETICAL

56220 (AD-A—049118) **Runaway electrons in collective electric fields. Interim report.** Hui, B.H.; Winsor, N.K. (Naval Research Lab., Washington, DC (USA)). Sep 1977. Contract E(49-20)-1006. 18p. (NRL-MR—3614). NTIS PC A02/MF A01.

The interactions of runaway electrons with the anomalous-Doppler shifted mode and a bump-on-tail mode are studied numerically using the Fokker-Planck equation with a self-consistent quasi-linear diffusion operator. The resulting frequency spectrum and the synchrotron radiation power agree with the experimental observations. Furthermore it is shown that there is a velocity threshold, below which electrons are not pitch-angle scattered by the self-consistent electric fields. The observed long-time behavior of synchrotron radiation data implies that this velocity threshold must shift to higher velocity as an experiment progresses.

56221 (AD-A—050093) **Ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas. Interim report.** Jacobs, V.L.; Davis, J.; Rogerson, J.E.; Blaha, M. (Naval Research Lab., Washington, DC (USA)). Nov 1977. 17p. (NRL-MR—3572). NTIS PC A02/MF A01.

The results of calculations of the ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas are presented for electron temperatures in the range 10,000 to 10,000,000 K (about 1 to 1000 eV). The ionization structure is determined using the steady-state corona model, in which electron impact ionization from the ground states is balanced by direct radiative and dielectronic recombination. Using an improved theory, detailed calculations are carried out for the dielectronic recombination rates in which account is taken of all radiative and autoionization processes involving a single-electron electric-dipole transition of the recombining ion. The radiative energy loss processes considered are electron-impact excitation of resonance line emission, direct radiative recombination, dielectronic recombination, and electron-ion bremsstrahlung. For all three elements, resonance line emission resulting from 2s - 2p transitions produces a broad maximum in the energy loss rate near 100,000 K (about 10 eV). (Author)

56222 (ORNL/TM—6366) **Impurity behavior during neutral beam injection and gas puffing into ORMAK.** Isler, R.C.; Crume, E.C.; Howe, H.C. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 55p. Dep. NTIS, PC A04/MF A01.

Variations of the intensities of spectral lines are utilized to determine the extent to which the impurity concentrations of ORMAK-produced plasmas are altered by neutral beam injection and, in some cases, by the simultaneous introduction of a puff of hydrogen. Concurrent variations of oxygen emissions resulting from alterations in the profiles of electron temperatures and concentrations are taken into account through solving the coupled continuity equations of the several ionic species of this element. Ad hoc transport velocities are utilized and a complete recycling model is assumed.

56223 (PPPL—1392) **Low-Z impurities in PLT.** Hinnov, E.; Suckewer, S.; Bol, K.; Hawryluk, R.; Hosea, J.; Meservey, E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Nov 1977. Contract EY-76-C-02-3073. 25p. Dep. NTIS, PC A02/MF A01.

Low-Z impurities concentrations (oxygen and carbon) have been measured in different discharges in PLT. The contribution to Z/sub eff/, influx rates and radiation losses by oxygen and carbon were obtained. An inverse correlation was found between the low-Z impurity density (and also the edge ion temperature) and the high-Z impurity (tungsten) density. A one-dimensional computer transport model has been used to calculate the spatial profiles of different oxygen and carbon ionization states. This model predicts that fully stripped oxygen and carbon ions should exist near the plasma periphery.

56224 (PPPL—1463) **Numerical determination of axisymmetric toroidal magnetohydrodynamic equilibria.** Johnson, J.L.; Dalhed, H.E.; Greene, J.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jul 1978. Contract EY-76-C-02-3073. 47p. Dep. NTIS, PC A03/MF A01.

Numerical schemes for the determination of stationary axisymmetric toroidal equilibria appropriate for modeling real experimental devices are given. Iterative schemes are used to solve the elliptic nonlinear partial differential equation for the poloidal flux function psi. The principal emphasis is on solving the free boundary (plasma-vacuum interface) equilibrium problem where external current-carrying toroidal coils support the plasma column, but fixed boundary (e.g., conducting shell) cases are also included. The toroidal current distribution is given by specifying the pressure and either the poloidal current or the safety factor profiles as functions of psi. Examples of the application of the codes to tokamak design at PPPL are given.

56225 (UCRL—50051-77-4, pp 45-65) **Applied plasma physics.** 28 Feb 1978.

In Magnetic fusion energy quarterly report, October—December 1977.

Applied Plasma Physics is a major sub-organizational unit of the MFE Porgram. It includes Fusion Plasma Theory and Experimental Plasma Research. Fusion Plasma Theory has the responsibility for developing theoretical-computational models in the general areas of plasma properties, equilibrium, stability, transport, and atomic physics. This group has responsibility for giving guidance to the mirror experimental program. There is a formal division of the group into theory and computational; however, in this report the efforts of the two areas are not separated since many projects have contributions from members of both. Under Experimental Plasma Research, we are developing the intense, pulsed ion-neutral source (IPINS) for the generation of a reversed-field configuration on 2XIIB. We are also studying the feasibility of utilizing certain neutron-detection techniques as plasma diagnostics in the next generation of thermonuclear experiments.

56226 Ground-state populations of atomic hydrogen and hydrogen-like ions in nonthermal plasmas, and collisional-radiative recombination and ionization coefficients. Drawin, H.W.; EMARD, F. (CEA CENTRE D'ETUDES NUCLEAIRES DE FONTENAY-AUX-ROSES, 92 (FRANCE). DEPT. DE PHYSIQUE DU PLASMA ET DE LA FUSION CONTROLEE). *Physica, B, C;* **94**: No. 1, 134-140(Apr 1978).

The populations of atomic hydrogen and hydrogen-like ions have been calculated using a collisional-radiative model. The global collisional-radiative excitation coefficients rsub(j)sup((0)) and rsub(j)sup((1)) valid for homogeneous-stationary and/or quasi-homogeneous quasi-stationary plasmas were published recently. The present paper contains in tabulated form the ground state populations and Saha decrements for the homogeneous stationary state, and the collisional-radiative recombination and ionization coefficients.

56227 Possible dependence of recombination on magnetic field. Fowler, R.G. (OKLAHOMA UNIV., NORMAN (USA)). *Phys. Lett., A;* **65**: No. 3, 239-240(6 Mar 1978).

It is suggested that recent beam experiments which were designed to disprove Bohn diffusion may instead have revealed the existence of unsuspected magnetic effects upon recombination.

56228 Spectroscopy of plasmas carrying sound waves. II. Spectral line profiles. Byerley, A. (CHELSEA COLL. OF SCIENCE AND TECHNOLOGY, LONDON (UK)); MCWHIRTER, R.W.P.; WILSON, R. *J. Phys., B (London);* **11**: No. 4, 613-621(28 Feb 1978).

This paper extends the theory, developed in an earlier paper (McWhirter and Wilson. J. Phys. B.; 7:1588 (1974)) on the intensities of spectral lines emitted by a plasma in which a sound wave is propagating, to a consideration of their profiles. The expression that is presented for the profiles is based on the assumption that the spectral lines are broadened and shifted by the combined Doppler effects of motion associated with the sound wave and with thermal motion. The treatment covers isothermal and adiabatic sound waves in two plasma conditions, namely, (i) uniform low-density plasma; (ii) low-density plasma of uniform pressure and having a temperature gradient. The results show that the profiles have a characteristic asymmetric shape and that for a sound wave propagating towards the observer the centre of gravity of the profile is blue shifted although there is no net flow of plasma.

56229 Electron impact ionisation results by the Z = infinity method. Sampson, D.H.; GOLDEN, L.B. (PENNSYLVANIA STATE UNIV., UNIVERSITY PARK (USA)). *J. Phys., B (London);* **11**: No. 3, 541-549(14 Feb 1978).

The procedure given previously by Golden and Sampson (J. Phys. B.; 10:2229 (1977)) for obtaining ionisation results for highly charged ions with finite Z from the scaled results for hydrogenic ions with Z = infinity is modified slightly and a prescription is given for including the effects of lowered ionisation potentials occurring in dense plasmas. The results by this approach are then compared with various experimental, theoretical and semi-empirical results for ionisation of He-like, Li-like and Be-like ions with Z/N in the range 2 < - Z/N < approximately 3, where N is the number of bound electrons per ion. It appears that, for Z/N in this range, the method gives results at least as accurate as those obtained by the exchange classical impact-parameter method and more accurate than the other available theoretical and semi-empirical results. The accuracy of the approach should improve as Z/N is increased.

56230 Relativistic Boltzmann theory for a plasma. III. Viscous phenomena. van ERKELENS, H.; VAN LEEUWEN, W.A. (AMSTERDAM UNIV. (NETHERLANDS). INSTITUUT VOOR THEORETISCHE FYSICA). *Physica, A;* **90**: No. 1, 97-108(Jan 1978).

The linear laws pertaining to viscous phenomena are derived for a relativistic plasma in an electromagnetic field. The results found in this microscopic context fit precisely into the general scheme obtained on a macroscopic level by Hooyman, de Groot and Mazur.

56231 FIFPC: a fast ion Fokker-Planck code. Fowler, R.H.; SMITH, J.; ROME, J.A. (OAK RIDGE NATIONAL LAB., TENN. (USA)). *Comput. Phys. Commun.;* **13**: No. 5, 323-340(1978).

The distribution function of fast ions resulting from neutral beam injection into a Tokamak plasma is calculated. The Fast Ion Fokker-Planck Code (FIFPC) also computes the momentum and power delivered to the electrons and ions in the background plasma, the power lost through charge exchange, the particle input to the plasma, and other quantities of interest. FIFPC solves the Fokker-Planck equation that describes the slowing down process of fast ions in a Tokamak plasma. This two-dimensional velocity space equation is transformed into sets of implicit finite difference equations to obtain the time-dependent solution or to obtain the steady-state solution directly. Two methods of solution are employed for the time dependent problem. One method uses the Crank-Nicolson scheme. The resulting set of finite difference equations is solved by using the strongly implicit procedure (SIP) developed by Stone. The other method is based upon the alternating direction implicit (ADI) scheme which results in equations with tridiagonal coefficient matrices that are solved using a standard technique. The steady-state finite difference equations are solved by the SIP technique.

56232 Electrostatic binding energy of plasma and the relation to elementary constants. Hora, H.; RAY, P.S. (NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). DEPT. OF THEORETICAL PHYSICS). *Atomkernenergie;* **31**: No. 1, 62(1978). (In German).

56233 Thermodynamics of nonideal low-temperature plasma. Karsnikov, Y.G. (Moscow Physicotechnical Institute). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 270-274(Aug 1977).

An expression for the Coulomb part of the thermodynamic potential of a plasma is obtained, on the basis of a quantum physical model of the plasma and a diagram technique, in the form of an expansion of the chiral type in the parameter zeta=λ^{-3} exp($\beta\mu$). Besides the known terms proportional to zeta/sup 3/2/, zeta^{2}ln zeta, and zeta^2, terms proportional to ~zeta/sup 5/2/lnzeta and zeta/sup 5/2/ are also calculated. The latter terms contain contributions from the states of both the continuum and the discrete energy spectrum. The results are used for a plasma in which exchange effects are small but the direct interaction plays an essential role.

56234 Coherent-electron radiation pressure on a beam surface. Krasovitskii, V.B. *Zh. Tekh. Fiz.;* **47**: No. 1, 10-19(Jan 1977). (In Russian).

A formula has been obtained for the breaking force in consequence of radiation acting on a surface of a linear beam of relativistic electrons spreading in a plasma under conditions of the beam instability. Detailed consideration is given to a physical mechanism explaining the effect and possibilities of its utilization for beam radial focusing.

56235 Collisionless emission of radiation by an inhomogeneous plasma. Meierovich, B.E. *Zh. Eksp. Teor. Fiz.;* **71**: No. 9, 1045-1058(Sep 1976). (In Russian).

Collisionless emission of radiation by an inhomogeneous plasma due to the finite motion of charges in the field of external forces and collective interaction forces is studied. The intensity of the radiation is inversely proportional to the square of the transverse dimensions of the plasma. It apparently makes the main contribution to the radiation from a vacuum spark and other relativitstic beams compressed to a small size by collective interaction forces. The intensity of the collisionless radiation is calculated by taking into account Fermi statistics of the electrons. The spectral radiance in the low frequency range increases with frequency, reaches a maximum at the frequency of the finite motion of the emitters and then decreases. Measurement of collisionless radiation emission by a plasma compressed to a small size by the pinch effect is a natural way of diagnosing the plasma.

PLASMA PRODUCTION

REFER ALSO TO CITATION(S) 56195

56236 Supercooled quasistationary beam plasma of decreased temperature. Snezhkin, E.N.; Nezlin, M.V. (I. V. Kurchatov Institute of Atomic Energy). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 3, 481-486(Sep 1977).

The conditions for the production of a deeply supercooled quasistationary plasma by an intense electron beam in a dense gas are considered. The paper consists of two parts, experimental and theoretical, and is a direct continuation of the first experiments [S. V. Antipov et al., Sov. Phys. JETP 38, 931, (1974)] on the production of a supercooled plasma with a beam. The principal method of lowering the electron temperature T/sub e/ of a helium plasma, just as in the earlier study, involves addition of molecular hydrogen. Optimization of the experimental conditions has made it possible to decrease T/sub e/ by a factor 2—3 compared with the earlier work. Under the new condition, at a helium-hydrogen mixture density (2—8) x 10^{18} cm^{-3}, the electron temperature is T/sub e/< or ≈0.2 eV and their concentration is N/sub e/> or ≈1 x 10^{14} cm^{-3}. A medium with these parameters is in a high state of disequilibrium. Thus, the plasma density exceeds the thermodynamic-equilibrium value (determined by the Saha formula) by approximately 20 orders of magnitude (!). The corresponding excess of the concentration of the excited helium atoms is even larger. Such a medium is of interest for applications connected with the properties of excited atoms and molecules and with kinetics of recombination. The presented calculations of the plasma parameters (N/sub e/ and T/sub e/) agree with the experimental data.

PLASMA INSTABILITIES

REFER ALSO TO CITATION(S) 56181, 56182

56237 (AD-A—050388) **Evolution of parametrically excited instabilities in a magneto-plasma column. Interim report Apr 74—Jun 77.** Yip, T.Q.; Cheo, B.R. (Polytechnic Inst. of New York, Brooklyn (USA). Dept. of Electrical Engineering and Electrophysics). Jun 1977. 109p. (POLY-EE/EP—77-028). NTIS PC A06/MF A01.

Experiments on parametric decay instabilities have been conducted in a hollow cathode arc generated plasma in a static magnetic field. A phenomenological model is used to describe the observed phenomena, and to determine the decay rate at various power levels, the linear and non-linear damping terms. An accurate estimate of the threshold power level is also obtained. And with the pump power switched from the fixed level to another, also above the threshold, the growth of the waves is also studied. The linear dependence of

the decay and growth rate y on power is clearly demonstrated, and the experimental values are compared to theoretically calculated ones to obtain the physical picture. The natural or linear damping of the electrostatic ion cyclotron wave is found to be due to ion-neutral collision. The non-linear damping term which yields information on the saturation mechanisms of the wave, is found to be proportional to the square of the amplitude.

56238 (PPPL—1328) Nonlinear excitation of convective cells by mode coupling of drift waves. Okuda, H.; Cheng, C.Z. (Princeton Univ., NJ (USA). Plasma Physics Lab.). May 1977. Contract EY-76-C-02-3073. 18p. Dep. NTIS, PC A02/MF A01.

It is shown that the nonlinear interaction of drift waves resonantly excites the convective cells at the wavelengths comparable to the ion gyroradius (k/sub perpendicular to rho/sub i/ approximately 1) where the drift waves are highly dispersive and the growth rates are the maximum. The results of numerical simulations are consistent with theoretical predictions. The effect of magnetic shear is also considered.

56239 Necessary stability criterion for plasma equilibria with tensor pressure. Nelson, D.B.; Spies, G.O.; Hedrick, C.L. (Thermonuclear Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Fluids;* **21**: No. 10, 1742-1745(Oct 1978).

A necessary stability criterion is derived which is valid within ideal magnetohydrodynamics, one-fluid guiding center theory, and double-adiabatic theory. The equilibria considered are such that the magnetic field lines are either closed or intersect insulating end plates. Due to the inclusion of ballooning perturbations, the criterion is stronger than that for stability to line-preserving perturbations; unlike the latter, it is violated in the bulk of the plasma of Elmo bumpy torus-like equilibria. This disagreement with observations suggests that kinetic effects must be included to explain the experiment.

56240 Effect of equilibrium flow on the resistive tearing mode. Killeen, J.; Shestakov, A.I. (Magnetic Fusion Energy Computer Center, Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Fluids;* **21**: No. 10, 1746-1752(Oct 1978).

The resistive tearing instability of an incompressible plasma is investigated for the plane sheet pinch in which the equilibrium magnetic field, xB/sub x/0+zB/sub z/0, depends only on y. The usual assumption is to take $v_0=0$, but here the effect of a nonzero v_0 is studied. A linear, time-dependent model is used in which perturbations take the form $f_1(y,t)\exp[i(k/\text{sub } x/x+k/\text{sub } z/z)]$. A new initial-value code has been developed to solve the resulting higher-order system of equations. For a symmetric magnetic equilibrium and modes $\alpha<1$, where $\alpha=a(k/\text{sub } x/^2+k/\text{sub } y/^2)/\text{sup } 1/2/$, an exponential growth develops. The growth rate, $p=\omega\text{tau/sub } r/$, is computed as a function of α and $S=\text{tau/sub } r//\text{tau/sub } h/$, for several values of v_0. The effect is to reduce p for all α, and to reduce the marginal α for instability for values of v_0 of the order of the resistive diffusion velocity. Results for larger values of v_0 are briefly discussed. For asymmetric tearing, the effect of the diffusion velocity depends on its sign. The velocity may have either a stabilizing or destabilizing influence on both the growth rates and the critical α for instability.

56241 Guiding center helically symmetric plasmas. Schmidt, M.J.; Vahala, G. (Courant Institute of Mathematical Sciences , New York University, New York, New York 10012). *Phys. Fluids;* **21**: No. 10, 1758-1765(Oct 1978).

The stability analysis of nearly cylindrical magnetically confined plasma is generalized to include the effects of pressure anisotropy. Specifically, the equilibrium and normal mode equations for helically symmetric plasmas are derived and it is shown that these equations reduced to all previous diffuse profile bumpy theta pinch and helical calculations. The equations presented are valid for arbitrary helical wavenumber k, arbitrary degree of helicity L, and O (δ^0) pressure anisotropy, where δ measures the percent deviation of the plasma surface from that of a cylinder. Numerical calculations of the effect of pressure anisotropy on locally unstable modes are presented.

56242 Kinetic theory of m=1 internal instabilities. Drake, J.F. (Department of Physics, University of California, Los Angeles, California 90024). *Phys. Fluids;* **21**: No. 10, 1777-1789(Oct 1978).

The internal m=1 instability is investigated kinetically over the entire range of collisionality of the plasma using a pitch-angle-scattering collision operator to represent electron-ion collisions. As a function of the ratio of plasma to magnetic pressure β, the ideal magnetohydrodynamic driving energy, and the collisionality, the m=1 mode falls into six basic categories. In the high β (typically $\beta\text{m/sub i//m/sub e/}>1$), low collisionality regime of present tokamak discharges, the Doppler effects associated with electron thermal motion along B strongly modify the structure and growth rate of the instability. Electron thermal effects are found to be negligible, however, when the ideal magnetohydrodynamic driving energy is large. The effect of density and temperature gradients on the instability are also studied. When the electron diamagnetic frequency $\omega/\text{sub asterisk/}$ is large, two distinct modes are typically found, one with $\omega\approx\omega/\text{sub asterisk/}$ driven by the electron temperature gradient, and a second with vertical-barωvertical-barvery-much-less-than$\omega/\text{sub asterisk/}$ driven by the magnetic energy. Simple descriptions of the mode in each of the regimes are presented.

56243 Harmonic oscillating two-stream instability in lower-hybrid heating. Sperling, J.L.; Harvey, R.W. (General Atomic Company, San Diego, California 92138). *Phys. Fluids;* **21**: No. 10, 1803-1807(Oct 1978).

The harmonic oscillating two-stream instability is a four-wave process which arises when a finite amplitude wave field with frequency ω_0 destabilizes waves at harmonics of ω_0. The importance of the instability arises in its ability to transfer wave energy from slow electrostatic waves near the lower-hybrid frequency to waves at higher frequencies. The harmonic oscillating two-stream instability could alleviate the condensation problem which has arisen in recent cascade theories.

56244 Multidimensional theory of the inhomogeneous beam-plasma instability. Shanahan, W.R. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **21**: No. 10, 1808-1817(Oct 1978).

A combined analytic and numerical study of the effect of a plasma density gradient on the beam-plasma instability is presented. After a thorough discussion of the qualitative aspects of this problem, emphasis is placed on the development of a theory which can reveal the interplay between the gradient and the multidimensional aspects of the instability. Using fluid equations, a differential equation is derived for the electrostatic potential. An integral representation for the solution of this equation is derived and its asymptotic evaluation presented. Explicit comparison is made between this asymptotic result and a direct numerical integration of the basic equations. The predictions of the theory are presented for the two-dimensional case, both for the case in which the beam propagates along the direction of the gradient and for that in which the beam is propagating at an angle to this direction. Some brief remarks are made concerning the fully three-dimensional case.

56245 Pressure anisotropy stabilization of axisymmetric mirror machines. Weitzner, H. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Phys. Fluids;* **21**: No. 10, 1832-1839(Oct 1978).

The stability of a two species, anisotropic pressure, axisymmetric plasma is studied using the guiding center plasma model. Successively, asymptotic expansions are applied appropriate to a long, thin plasma, and to a plasma with flux surfaces close to cylinders. The resultant stability problem may be cast as an ordinary differential equation eigenvalue problem or as a problem in the calculus of variations. It is shown that low beta plasmas cannot be confined and be stable although plasmas may be stable in which the pressure gradients are nonzero where the pressure tends to zero. Stable profiles are given; these profiles include the possibility of field reversed regions. These stable profiles require the anisotropic species to be cold near the axis. Rather than absolute stability, a weaker condition is also considered which for fixed azimuthal mode number vertical-barmvertical-bar puts the point of accumulation of the spectrum of modes on the stable side. It is hoped that such a condition may yield systems stable to vertical-barmvertical-bar small modes although not all values of vertical-barmvertical-bar. This condition is more readily satisfied and allows more reasonable profiles near the axis.

56246 Stabilization of the axisymmetric instability in the poloidal divertor experiment tokamak. Jardin, S.C. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). *Phys. Fluids;* **21**: No. 10, 1851-1855(Oct 1978).

Passive stabilization, associated with the mutual inductances of the field shaping coils with the plasma and with each other, can stabilize the axisymmetric magnetohydrodynamic instability in the Princeton poloidal divertor experiment device that was observed in earlier numerical studies.

56247 Cyclotron maser instability for general magnetic harmonic number. Uhm, H.; Davidson, R.C.; Chu, K.R. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Fluids;* **21**: No. 10, 1877-1886(Oct 1978).

The cyclotron maser instability for general magnetic harmonic number transverse electric (TE) and transverse magnetic (TM) waveguide modes in a conducting cylinder of radius R/sub c/ are examined. The analysis is carried out for a hollow electron beam (radius R_b) propagating parallel to a uniform axial magnetic field $B_0e/\text{sub } z/$. It is assumed that $\nu/\gamma_0\text{very-much-less-than}1$, where ν is Budker's parameter and γ_0mc^2 is the electron energy in a frame of reference moving with the beam axial velocity $\beta/\text{sub } b/ce/\text{sub } z/$. One of the most important features of the analysis is that the

instability growth rate for magnetic harmonic numbers s=2,3,... is comparable to the growth rate of the fundamental (s=1) mode, particularly for moderate electron energy [β_0= (1-1/$\gamma^2$0)/sup 1/2/ > or ≈0.4]. Moreover, it is shown that the instability growth rate can be maximized by appropriate choice of the geometric parameter R_0/R/sub c/.

56248 Stability of bound eigenmode solutions for the collisionless universal instability. Antonsen, T.M. Jr. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev. Lett.;* **41**: No. 1, 33-36(3 Jul 1978).

The collisionless universal instability in slab geometry with a sheared magnetic field is considered. It is shown from the differential eigenvalue equation that no bound growing eigensolutions exist. The method of solution consists of first assuming that exponentially growing eigenmodes exist and then forming quadratic quantities from which a contradiction is obtained. The relation between the eignmodes and convective modes is discussed.

56249 Electron current driven ion acoustic standing wave instability. Schrittwieser, R. (INNSBRUCK UNIV. (AUSTRIA). INST. FUER THEORETISCHE PHYSIK). *Phys. Lett., A;* **65**: No. 3, 235-238(6 Mar 1978).

By means of a positively biased grid an electron current driven instability is excited in a single ended Q-machine. The instability shows the behaviour of a half standing ion acoustic wave with nodes at the hot plate and the grid. For high grid biases an increased plasma temperature is found.

56250 Experiments on negative-feedback stabilization of helical plasma instability in a TO-1 tokamak. Artemenkov, L.I.; Ivanov, N.V.; Kakurin, A.M.; Mukhin, P.A.; Papkov, L.N.; Chudnovskii, A.N.; Shvindt, N.N.; Gvozdkov, Y.V.; Cherkashin, M.Y. *JETP Lett. (USSR) (Engl. Transl.);* **27**: No. 2, 99-103(20 Jan 1978).

We report here the first experiments on stabilization of helical instability of a plasma pinch in a TO-1 tokamak by the negative feedback method [A. I. Morozov and L. S. Solov'ev, Sov. Phys. Tech. Phys. 9, 1214 (1965); V. V. Arsenin and V. A. Chuyanov, At. Energ. 25, 141 (1968); V. V. Arsenin, At. Energ. 28, 141 (1970) and 33, 691 (1972); Yu. P. Ladikov-Roev and Yu. M. Samoilenko, Sov. Phys. Tech. Phys. 42, 1644 (1973); R. Lowder and K. Thomassen, Phys. Fluids 16, 1497 (1973); J. Hugill, Plasma Physics 16, 1200 (1974), K. Bol et al., in: Proc. Fifth Intern. Conf. of Plasma Physics and Controlled Nucl. Fusion Research, Tokyo, 1974, IAEA, Vienna, 1975, Vol. I, CN-33/A4-2; R. A. Demirkhanov, A. G. Kirov, L. F. Ruchkov, A. V. Sukachev, V. B. Maiburov, and A. V. Nyushkov, JETP Lett. 26, 81 (1977)].

56251 Threshold of electromagnetic instability in a magnetic neutral sheet. Yamanaka, K. (NAGOYA UNIV. (JAPAN). INST. OF PLASMA PHYSICS). *Phys. Scr.;* **17**: No. 1, 15-22(Jan 1978).

The structure of electromagnetic perturbations in a magnetic neutral sheet is analyzed within the framework of a Vlasov-Maxwellian picture. In reference to Harris' equilibrium state, a boundary value problem is formulated and solved to give the possible existence of a low-frequency electromagnetic wave of compresns are presented. The investigation used the inner 17m surface of the Parkes telescope which has recently been provided with a precision surface. The sources were selected from H2 regions with strong CS emission, CO emission or H_2CO absorption.

56252 Phenomenon of parametric trapping of electromagnetic waves in an inhomogeneous plasma. Silin, V.P.; Starodub, A.N. (P. N. Lebedev Institute of Physics, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 725-730(Oct 1977).

A theory is developed of absolute parametric aperiodic instability in a spatially inhomogeneous plasma, when the electromagnetic waves generated in the plasma are trapped by the plasma near the peaks of the pumping-wave field.

56253 Modulational instability of magnetohydrodynamic waves in a plasma. Al'tshul', L.M. (Novosibirsk State University). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 3, 454-459(Sep 1977).

We study the interaction between magnetohydrodynamic waves and a plasma with βvery-much-less-than1. We show that this leads to a modulational instability for the fast magnetosonic waves at a well defined level of oscillation energy. As a result of the development of this instability the particle density and wave energy density start to increase in a certain region. The modulational instability of a beam of almost parallel waves can be stabilized in the weakly nonlinear stage and a wave channel is then formed with an increased plasma density to which the waves are confined due to refraction. In the case of an isotropic wave distribution the compression of the plasma may proceed until the energy of the oscillations and of the particles becomes comparable with the energy of the stationary magnetic field. We discuss the possibility of observing the modulational instability of fast magnetosonic waves under natural conditions.

56254 Two plasmon decay and generation of the (3/2) ω_0 harmonic. Silin, V.P.; Starodub, A.N. (P. N. Lebedev Physical Institute, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 3, 465-468(Sep 1977).

The dependence of the threshold value of the field intensity on the wave vector of growing plasma perturbations is studied. The spatial region of development of absolute parametric instability is determined. It is shown that the size of the region is of the order of the size of the plasma corona produced of a laser-irradiated solid target. It is predicted that the generation intensity of the (3/2) ω_0 harmonic should increase sharply and have a threshold. The increase is due to the pump field attaining such high values that longwave plasmons, capable of producing the harmonic as a result of resonance merging with the pump wave, are formed in the decay.

56255 Resonance instability of small-scale plasma perturbations. Vas'kov, V.V.; Gurevich, A.V. (Institute of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 3, 487-494(Sep 1977).

We consider the conditions for the excitation, in the reflection region of ordinary electromagnetic waves, of quasistationary small-scale plasma-concentration perturbations, elongated in the direction of the magnetic field. The stratification parameter, which characterizes the transverse dimension of the produced inhomogeneities, is found to be ≈ (D/sub e/c/ω/sub H/)/sup 1/2/ (D/sub e/ is the Debye radius and ω/sub H/ is the electron gyrofrequency). The stratification parameter is usually not large, less than the ion Larmor radius. A resonant amplification of the instability is observed at a perturbing-wave frequency equal to double the electron gyrofrequency.

56256 Effect of trapped particles in the regime of cyclotron resonance. Krlin, L. (CESKOSLOVENSKA AKADEMIE VED, PRAGUE. USTAV FYZIKY PLAZMATU). *Czech. J. Phys.;* **27**: No. 6, 640-654(1977).

The motion of particles in a finite amplitude wave, propagating obliquely to the homogeneous magnetostatic field is discussed. As follows from simple integral properties, in the neighbourhood of Doppler-shifted cyclotron resonance similar trapping effects appear as in a plasma without a magnetostatic field. The consequences of this trapping are discussed, mainly the possibility of a strong absorption of the wave, and the origin of stochastic instabilities caused by the perturbation of an effective trapping potential and leading to the acceleration of particles.

56257 Cyclotron instability of plasma with the collisional ion distribution in an open trap. Arsenin, V.V. (GOSUDARSTVENNYJ KOMITET PO ISPOL'ZOVANIYU ATOMNOJ EHNERGII SSSR, MOSCOW. INST. ATOMNOJ EHNERGII). *Fiz. Plazmy;* **1**: No. 6, 1000-1003(1975). (In Russian).

Cyclotron instability of a plasma with collisional ion distribution on the edge of an open trap is considered. It is shown that in the case of neutral particle beam injection into plasma the ion distribution on the edge of the plasma may be anisotropic when the inner distribution is a collisional one. This anisotropic layer is the source of plasma instability even if the density in it is lower than the threshold of local perturbations.

56258 Experimental determination of a stability factor in the "finger-ring" Tokamak. Bortnikov, A.V.; BREVNOV, N.N.; GERASIMOV, S.N.; ZHUKOVSKII, V.G.; PERGAMENT, V.I.; KHIMCHENKO, L.N. (GOSUDARSTVENNYJ KOMITET PO ISPOL'ZOVANIYU ATOMNOJ EHNERGII SSSR, MOSCOW. INST. ATOMNOJ EHNERGII). *Fiz. Plazmy;* **1**: No. 6, 931-937(1975). (In Russian).

Experimental results are presented relating to the measurement of safety factor q in a ring-type tokamak. The minimal value of q=4 at the discharge current I=34 KA and the toroidal magnetic field Bsub(T)=0.8 T. The critical current shows increases linearly with Bsub(T). In a quasistationary stage of a discharge the plasma column has a constant cross section and grows in the centre-to-periphery direction. Experimental value of the safety factor and its dependence on discharge parameters are rightly described by theoretical relations. On the basis of the relation conclusion is made as to the advantages of a tokamak with a plasma column cross section extended along the major axis of the system.

56259 Flute oscillations of rarefied plasma with inhomogeneous ion drift. Putvinskii, S.V.; TIMOFEEV, A.V. (GOSUDARSTVENNYJ KOMITET PO ISPOL'ZOVANIYU ATOMNOJ EHNERGII SSSR, MOSCOW. INST. ATOMNOJ EHNERGII). *Fiz. Plazmy;* **1**: No. 6, 990-999(1975). (In Russian).

The paper is concerned with flute oscillations of a rarefied plasma with a nonuniform ion drift. It is shown that if the ion drift speed in a nonuniform field depends on the radius, the ion and larmour branches of flute oscillations may be damping. The damping effect is conditioned by resonance interaction of oscillations with the ion drift. Numerical methods were used to determine the depen-

dence of the damping decrement of the flute oscillations of ion and larmour branches on plasma density, degree of the magnetic field nonuniformity and ion dispersion over transverse energies.

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 56243

56260 Energy anisotropy instabilities in high-beta plasmas: A comparison of various kinetic and fluid descriptions. Cayton, T.E. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **21**: No. 10, 1790-1802(Oct 1978).

The Vlasov-fluid model is employed to study linear perturbations of a particular class of magnetized, infinite, homogeneous equilibria. The dispersion properties of waves and anisotropy driven instabilities with frequencies at or below the ion cyclotron frequency are used to compare and contrast the Vlasov-fluid model with other well-known models of a high-beta plasma. Although the various models differ widely in physical content and in the manner in which the dispersion equation is derived, the results obtained from any one of them agree with appropriate limits of all the others. The results illuminate the nature of the anisotropy driven fluid-like instabilities and illustrate their connection to kinetic descriptions that include dispersion due to finite gyroradius effects. For the simple equilibria that have been considered, no reason has been found not to regard the Vlasov-fluid model as an acceptable model of a high-beta plasma.

56261 Light absorption by ion acoustic turbulence in laser-produced plasmas. Manheimer, W.M.; Colombant, D.G. (Plasma Physics Division, Naval Research Laboratory, Washington, D.C. 20375). *Phys. Fluids;* **21**: No. 10, 1818-1827(Oct 1978).

A review of experiments on light absorption by laser-produced plasmas is presented and the need for another efficient absorption mechanism besides resonant absorption is clearly demonstrated. Laser light absorption by ion acoustic fluctuations is proposed as the missing absorption mechanism. Calculations of this absorption mechanism in a magnetized plasma are then presented.

56262 Hyrodynamic theory of plasma oscillations in quasi-two-dimensional systems. Dasgupta, B.B. (WISCONSIN UNIV., MILWAUKEE (USA)). *Phys. Lett., A;* **65**: No. 3, 229-230(6 Mar 1978).

It is shown that a hydrodynamic theory can be applied to calculate the dispersion relation of plasma oscillations in a quasi-two-dimensional system. It also leads to the conclusion that additional 'multipole' modes may exist in the system.

56263 Decay of an extraordinary wave into two lower-hybrid waves in an inhomogeneous plasma. Ramazashvili, R.R. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. Tech. Phys. Lett. (Engl. Transl.);* **4**: No. 1, 43-44(Jan 1978).

Instability growth rates are calculated for the decay of an extraordinary wave with a frequency larger than that of the lower-hybrid resonance.

56264 Real zeroes of the dielectric response function in 2-d classical plasmons. Calinon, R. (ECOLE POLYTECHNIQUE FEDERALE, LAUSANNE (SWITZERLAND)); MERLINI, D. (CENTRE DE RECHERCHES EN PHYSIQUE DES PLASMAS, LAUSANNE (SWITZERLAND)). *Helv. Phys. Acta;* **50**: No. 5, 700-703(30 Nov 1977).

From Swiss Physical Society spring meeting; Lausanne, Switzerland (14 - 15 Apr 1977).

Applying the results of a careful truncation scheme of the BBGKY equilibrium kinetic equations, recently worked out for a classical 2-d one component plasma, the authors investigate the possible occurrence of non-uniform states in the system; a real zero of the computed dielectric response function may appear in the zero frequency and strong coupling limit. Alternatively, using a linearized form of the first BBGKY equation and explicit computations, another integral equation is obtained. Both approaches locate a real zero in the range 0.8 <k/ksub(D)<1.2 for a value of the plasma parameter γsub(s) above the instability point γsub(c)=4.

56265 Effect of a particle source on the non-linear evolution of a monochromatic wave. Mikhailovskii, A.B.; Pyatak, A.I. (I. V. Kurchatov Institute of Atomic Energy). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 4, 721-725(Oct 1977).

We study the effect of a source of resonant particles on a nonlinear monochromatic wave in a plasma. We consider the case of a Langmuir wave when there is no magnetic field present and that of an Alfven wave under conditions of a toroidal geometry of the magnetic field. We show that a systematic change in the amplitude of the non-linear wave occurs when there is a source of particles present. We suggest that this effect may be important for the case of injection of fast neutral atoms into magnetic traps and also in problems of fast α-particles produced in a plasma in thermonuclear reactions and in problems of fast particle fluxes in the Earth's magnetosphere.

56266 Alfven and magnetosonic vortices in a plasma. Petviashvili, V.I.; Pokhotelov, O.A. (O. Yu. Shmidt Institute of Earth Physics, USSR Academy of Sciences). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 260-264(Aug 1977).

It is shown that Alfven and magnetosonic waves can exist in a plasma in the form of two- and three-dimensional vortices. The dispersion spreading of such vortices is impeded by nonlinear effects. Magnetosonic waves form a toroidal vortex that travels along the magnetic field with Alfven velocity. Nonlinear Alfven waves form along the magnetic field an axially symmetrical waveguide. Inside of which the plasma executes vortical oscillations in the azimuthal direction. MHD vortices of this kind are observed in the earth's magnetosphere.

56267 Linear interaction of electromagnetic waves in a neutral current layer of a plasma. Zheleznyakov, V.V. (Radiophysics Research Institute). *Sov. Phys. - JETP (Engl. Transl.);* **46**: No. 2, 292-296(Aug 1977).

Linear interaction of ordinary and extraordinary waves in a neutral current layer of a plasma is considered. The interaction is the result of violation of the geometric-optics approximation in a region adjacent to a plane with a zero magnetic field. The effectiveness of the interaction is determined by a parameter whose value is independent of the frequency. Analytic expressions for the degree of transformation are derived for the limiting cases of small and large values of the interaction parameter in comparison with unity; for arbitrary values of this parameter, the degree of transformation is obtained by numerical methods. The possibility is noted of using the effect in question for diagnostics of laboratory and cosmic plasma.

56268 Second harmonic generation by a source in a magnetoactive plasma. Erokhin, N.S.; MUKHIN, V.V. (AN UKRAINSKOJ SSR, KHARKOV. FIZIKO-TEKHNICHESKIJ INST.). *Pis'ma Zh. Tekh. Fiz.;* **3**: No. 9, 396-399(12 May 1977). (In Russian).

56269 Absorption of electromagnetic radiation pulse in a plasma. Plis, A.I.; SHCHEGLOV, V.A. (AN SSSR, MOSCOW. FIZICHESKIJ INST.; MOSKOVSKIJ EHNERGETICHESKIJ INST. (USSR)). *Zh. Tekh. Fiz.;* **47**: No. 1, 71-75(Jan 1977). (In Russian).

The problem of the monochromatic radiation transport in a plasma is discussed. A precision analytical solution describing the electromagnetic signal distribution in the conditions when the radiation is absorbed as a result of electron-ion and electron-neutral particles (atoms, molecules) collisions. Particular cases are analyzed.

56270 Conversion of an electromagnetic wave into longitudinal wave in inhomogeneous plasma. Paul, S.N. (DEPARTMENT OF PHYSICS, R.R.R. MAHAVIDYALAYA, P.O. KHANAKUL, DIST. HOOGHLY, WEST BENGAL (INDIA)). *Czech. J. Phys.;* **27**: No. 8, 873-879(1977).

The expression for the energy of a longitudinal acoustic wave due to the conversion of energy of a transverse electromagnetic wave passing through an inhomogeneous plasma was obtained. It is seen that the energy conversion process is significant in a medium with small density but a large density gradient. The energy conversion process was applied to ascertain the amount of mass ejection from hot astrophysical bodies.

56271 Self-focusing of electromagnetic waves in a layer of an opaque plasma. Isaev, V.A.; KRUGLOV, V.N.; POLUYAKHTOV, B.K. *Zh. Eksp. Teor. Fiz.;* **71**: No. 9, 1017-1020(Sep 1976). (In Russian).

Experimental data are presented on the dynamics of nonlinear penetration of electromagnetic waves into a plasma with ωsub(p) > ω. It is demonstrated that nonlinear increase of transparency of the layer may involve both self-focussing of the wave field reflected from the plasma as well as self-focussing of the radiation penetrating the opaque region.

56272 Oscillations and longitudinal waves in plasma. Galin, E. (ACADEMIA R.S.R., BUCHAREST (ROMANIA). INSTITUTUL DE FIZICA). *Stud. Cercet. Fiz.;* **28**: No. 4, 389-404(1976). (In Romanian).

The linear theory is developed for the study of the longitudinal plasma waves. Some special considerations were made on the propagation of the longitudinal ion-waves, for the reason of their assignment in plasma heating.

FUSION POWER PLANT TECHNOLOGY

56273 (BNWL-SA—6328) Economics of fusion-fission (hybrid) reactors. Deonigi, D.E. (Battelle Pacific Northwest Labs., Richland,

WA (USA)). Mar 1977. Contract EY-76-C-06-1830. 39p. Dep. NTIS, PC A03/MF A01.

This paper analyzes the range of allowable performance characteristics (capital costs, operating costs, plutonium production rate and thermal-to-electrical conversion) which will result in net benefits to the public through reduced electrical costs at levels ranging from zero to $20 billion. These targets for performance will be established in light of nine different development scenarios for the remaining electric generating alternatives.

56274 (GA-A—15026) **Doublet III.** Hubbard, E.L. (General Atomic Co., San Diego, CA (USA)). May 1978. Contract EY-76-C-03-0167-038. 20p. (CONF-780595—5). Dep. NTIS, PC A02/MF A01.

From Cryogenic Society of America meeting; Chicago, IL, USA (17 May 1978).

Doublet III is the largest fusion research project currently in operation. It is a magnetic confinement device which will generate reactorlike conditions in a hydrogen plasma. This presentation will emphasize the basic engineering design requirements and design philosophy of Doublet III. The results of engineering tests on Doublet III, which were successfully conducted last February, will also be presented. Efficient generation of power in future machines will require the development of suitable low temperature coil systems.

56275 (UCRL—50051-77-4) **Magnetic fusion energy quarterly report, October—December 1977.** Harrison, M.A.; McGregor, C.K. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Feb 1978. Contract W-7405-ENG-48. 77p. Dep. NTIS, PC A05/MF A01.

Separate abstracts were prepared for each of the three included sections. (MOW)

56276 (UCRL—50051-77-4, pp 1-26) **Open confinement systems.** 28 Feb 1978.

In Magnetic fusion energy quarterly report, October—December 1977.

The three confinement systems now in operation or under construction at LLL, i.e., 2XIIB, TMX, and MFTF, are described. Some of the research areas reported for 2XIIB include the following: (1) field-reversal experiments, (2) stabilizing streams, (3) data analysis of 2XIIB magnet power supply, (4) 40-kV neutral beam module, and (5) neutral beam control and monitoring system. Magnet field design studies are given for TMX. Some technical support studies and diagnostic studies are reported for the MFTF. (MOW)

56277 (UCRL—52000-78-5) **Energy and technology review.** Shay, H.D.; Crawford, R.B.; Prono, J.K.; Staehle, J.T. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1978. Contract W-7405-ENG-48. 38p. Dep. NTIS, PC A03/MF A01.

An abstract was prepared for the first section of this report. That section contains a review of the first 25 years of fusion research at Livermore. (MOW)

56278 (UCRL—52000-78-5, pp 1-13) **LLL magnetic fusion research: the first 25 years.** Post, R.F. May 1978.

In Energy and technology review.

From its inception, the Laboratory has supported research directed at tapping controlled fusion. Our magnetic fusion energy program--now one of the major elements of the national fusion energy research effort--dates back to the Laboratory's founding in 1952. This article reviews the program's beginnings, progress, and present status in terms of its ultimate goal: to demonstrate a practical and economical means of generating power from controlled fusion reactions.

56279 (UCRL—80631) **Tandem Mirror Reactor.** Moir, R.W.; Barr, W.L.; Bender, D.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 May 1978. Contract W-7405-ENG-48. 10p. (CONF-780508—28). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

A reactor based on this concept that produces 1000 MWe consists of a solenoidal magnet about 50 to 100 m long. A cylindrical blanket is used for energy recovery and tritium breeding. Thus the reactor itself is simple and of low technology. The end plugs, however, are of high technology, having the high magnetic fields needed to confine the high-pressure plasma and the high injection energy (0.6 to 1.2 MeV) needed to achieve good magnetic confinement. A low technology, compact, economical hybrid fusion-fission reactor results from injection in the central cell as well as the ends, provided a means can be found to stabilize the end plugs against microinstabilities, particularly in small sizes (plug radius divided by ion gyroradius less than or equal to 10). The Q value is 1.8 and the power is 500 MWe, with 1000 kG of ^{233}U produced per year. If, on the other hand, the tandem is operated in the two-component mode (i.e., cold tritium plasma electrostatically contained into which a 100-200 keV D^0 beam is injected), then the end plugs can be stabilized by the outward flowing tritium plasma. Finally, we show that D-D burning tandem reactors appear feasible in large sizes and at high cost.

56280 (UCRL—80644) **Tandem mirror reactors.** Logan, B.G.; Barr, W.L.; Bender, D.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Jun 1978. Contract W-7405-ENG-48. 14p. (CONF-780811—2). Dep. NTIS, PC A02/MF A01.

From 7. conference on plasma physics and control; Innsbruck, Austria (23 Aug 1978).

We have made preliminary designs of tandem mirror fusion reactors burning D-T fuel and of fusion-fission (hybrid) tandem mirrors producing both fissile fuel and electricity. For the hybrid reactor, we find that by using stream-stabilized, 2XIIB-like plugs and by injecting 200-keV deuterium beams into a tritium-plasma target confined electrostatically in the solenoid (two-component operation), we obtain a useful Q (fusion power/injection power) near unity. The D-T tandem reactor parameters are optimized to obtain the minimum capital cost per kW(e) net. For $200/kW(e) of 1200-keV neutral beam injection power in the plugs and a solenoid cost of about $3 million per metre length, the optimum Q is near 5. To allow for more expensive injector costs, a higher D-T reactor Q of 10 is obtainable with either increased power output or decreased neutron wall loading. Fokker—Planck calculations show steady-state Q approximately 5 for D-D tandem reactors burning only deuterium fuel and its reaction products, with most of the charged-particle fusion power recovered in a direct converter.

56281 (WFPS-TME—081) **Low-cost Ignition Demonstration Reactor (IDR) scoping study.** Howland, H.R.; Schultz, J.H.; Varljen, T.C.; Heck, F.M.; Lee, A.Y.; Smith, R.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). 30 Sep 1977. Contract W-7405-ENG-26. 108p. Dep. NTIS, PC A06/MF A01.

The design options for the IDR are outlined. Plasma considerations are discussed, and reference plasma parameters are picked for each option. The machine configuration for each option is described and compared. The cost for each option is given. Appendices deal with specialized design topics which bear on the engineering feasibility of the devices. (MOW)

56282 **Survey of applications of fusion-power technology for the chemical- and material-processing industries.** Steinberg, M.; Beller, M.; Powell, J.R. (Brookhaven National Lab., Upton, NY). *Energy Sources;* **3**: No. 3/4, 207-253(1978).

The major forms of energy available in amounts of 30 percent or greater of the total power developed in a controlled thermonuclear reactor (CTR) operating on a deuterium-tritium fuel cycle are (1) high-temperature thermal energy, (2) electric energy—high and low voltage, and (3) neutron and gamma high-energy radiation. The thermal and electric forms of CTR energy can be applied to supply a significant fraction of the needs of a conventional heavy chemical and material processing industry. The minor forms of CTR energy based on a deuterium-tritium fuel cycle, available in amounts less than 10 percent of the total power developed in CTR reactors, include ultraviolet energy from the plasma, secondary high-energy particle (p, α, β) energy, and ionized particle energy from the blanket. These forms will be useful mainly as a by-product from either thermal or electric CTR power generators. Eventually, larger ultraviolet efficiencies may be available from the advanced deuterium-deuterium fuel cycle.

BLANKET ENGINEERING

56283 (ANL/FPP-TM—111) **Fusion reactor safety studies, FY 1977.** Darby, J.B. Jr. (comp.). (Argonne National Lab., IL (USA)). Apr 1978. Contract W-31-109-ENG-38. 68p. Dep. NTIS, PC A04/MF A01.

This report reviews the technical progress in the fusion reactor safety studies performed during FY 1977 in the Fusion Power Program at the Argonne National Laboratory. The subjects reported on include safety considerations of the vacuum vessel and first-wall design for the ANL/EPR, the thermal responses of a tokamak reactor first wall, the vacuum wall electrical resistive requirements in relationship to magnet safety, and a major effort is reported on considerations and experiments on air detritiation.

56284 (BNWL-SA—6420) **Neutronics and thermal hydraulics of a tokamak hybrid blanket.** Perry, R.T.; McKinnon, M.A.; Teofilo, V.L.; Aase, D.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1977. Contract EY-76-C-06-1830. 15p. (CONF-771029—221). Dep. NTIS, PC A02/MF A01.

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

The design of a fissile fuel outside blanket adapted to the Tokamak Engineering Test Reactor (TETR) has been based upon near term technology. The modular blanket is composed of fuel rods, containment canisters, and helium coolant ducting with 316 SS being the material for both blanket structure and the cladding of the natural UO_2 fuel pins. Neutronic and thermal hydraulic scoping calculations were made to determine the blanket power and plutonium production rates, the peak cladding and coolant temperatures, as well as time-temperature response of fuel rods and coolants. The thermal hydraulic analysis was performed with the COBRA-IV-1 code with the power density distributions determined by ANISN neutronic transport computations. The resulting fluid conditions indicate a minimum coolant volume fraction of between 30 and 40%. Based on a power cycle of 50 seconds on and 10 seconds off, the cyclic temperature variations of the fluid and cladding will be 200°F and 300°F respectively. However, the temperature gradient along the radially situated fuel pins and the peak cladding temperatures are high even though the concomitant effects of Pu thermal power density buildup have been neglected.

MAGNET COILS AND FIELDS

56285 (CONF-780718—1) **Development and testing of toroidal field superconductors for fusion devices.** Fietz, W.A.; Lue, J.W.; Miller, J.R. (Oak Ridge National Lab., TN (USA)). 1978. 11p. Dep. NTIS, PC A02/MF A01.

From 7. cryogenic engineering conference; South Kensington, London, UK (4 Jul 1978).

Superconductors rated at 10-16 kA in a magnetic field of 8 T are being designed, manufactured, and tested in cooperative development programs between Oak Ridge National Laboratory (ORNL) and conductor manufacturers. Conductor specimens based on ideas previously submitted by the manufacturers were fabricated and tested along with others designed and fabricated at ORNL. The tests measure short sample currents, stability, pressure drop, and heat transfer. Conductor parameters include strand size, cable configuration, superconductor distribution within the conductor, and compaction.

POWER SUPPLIES, ENERGY STORAGE

REFER ALSO TO CITATION(S) 55187

COOLING SYSTEMS

REFER ALSO TO CITATION(S) 56284

56286 (CONF-780508—55) **Evaluation of steam as a potential coolant for nonbreeding blanket designs.** Stevens, H.C.; Misra, B.; Youngdahl, C.K. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 10p. Dep. NTIS, MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

Portions of document are illegible.

A steam-cooled nonbreeding blanket design has been developed as an evolution of the Argonne Experimental Power Reactor (EPR) studies. This blanket concept complete with maintenance considerations is to function at temperatures up to 650°C utilizing nickel-based alloys such as Inconel 625. Thermo-mechanical analyses were carried out in conjunction with thermal hydraulic analysis to determine coolant chennel arrangements that permit delivery of superheated steam at 500°C directly to a modern fossil plant-type turbine. A dual-cycle system combining a pressurized water circuit coupled with a superheated steam circuit can produce turbine plant conversion efficiencies approaching 41.5%.

HEATING AND FUELING SYSTEMS

56287 (CONF-780622—29) **Two- and three-dimensional neutronics analyses of the TFTR neutral beam injectors.** Santoro, R.T.; Lillie, R.A.; Alsmiller, R.G. Jr.; Barnes, J.M. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 7p. Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; San Diego, CA, USA (18 Jun 1978).

The two-dimensional discrete ordinates code DOT using an S_8 angular quadrature and the three-dimensional Monte Carlo code MORSE were each used to calculate the spatial dependences of the nuclear heating rates and neutron and gamma-ray scalar flux distributions in the injector. In the three-dimensional analysis, these data were estimated at several locations in a detailed model of the injector using accurate neutron and gamma-ray energy, spatial, and angular distributions to describe the radiation sources incident on the injector. (MOW)

56288 (ORNL/TM—6302) **Analysis of particle species evolution in neutral beam injection lines.** Kim, J.; Haselton, H.H. (Oak Ridge National Lab., TN (USA)). Jul 1978. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

Analytic solutions to the rate equations describing the species evolution of a multispecies positive ion beam of hydrogen due to charge exchange and molecular dissociation are derived as a function of the background gas (H_2) line density in the neutralizing gas cell and in the drift tube. Using the solutions, calculations are presented for the relative abundance of each species as a function of the gas cell thickness, the reionization loss rates in the drift tube, and the neutral beam power as a function of the beam energy and the species composition of the original ion beam.

56289 (UCID—17825) **Design of a continuously operated 1-keV deuterium-ion extractor.** Fink, J.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jun 1978. Contract W-7405-ENG-48. 42p. Dep. NTIS, PC A03/MF A01.

A novel grid structure that is cooled only by radiation and conduction is shown to be capable of continuously extracting 2.5 $kA.m^{-2}$ of 1-keV positive deuterium ions while dissipating a power loading of 0.4 $MW.m^{-2}$.

56290 (UCRL—52000-77-9) **Energy and technology review.** Shay, H.D.; Adye, A.P.; Crawford, R.B.; Jarman, B.D.; Staehle, J.T. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1977. Contract W-7405-ENG-48. 30p. Dep. NTIS, PC A03/MF A01.

Separate abstracts have been prepared for each of the 3 included sections. (MOW)

56291 (UCRL—52000-77-9, pp 1-8) **Neutral beams for magnetic fusion.** Hooper, B. Sep 1977.

In Energy and technology review.

Significant advances in forming energetic beams of neutral hydrogen and deuterium atoms have led to a breakthrough in magnetic fusion: neutral beams are now heating plasmas to thermonuclear temperatures, here at LLL and at other laboratories. For example, in our 2XIIB experiment we have injected a 500-A-equivalent current of neutral deuterium atoms at an average energy of 18 keV, producing a dense plasma (10^{14} particles/cm^3) at thermonuclear energy (14 keV or 160 million kelvins). Currently, LLL and LBL are developing beam energies in the 80- to 120-keV range for our upcoming MFTF experiment, for the TFTR tokamak experiment at Princeton, and for the Doublet III tokamak experiment at General Atomic. These results increase our long-range prospects of producing high-intensity beams of energies in the hundreds or even thousands of kilo-electron-volts, providing us with optimistic extrapolations for realizing power-producing fusion reactors.

56292 **Effect of transonic flow in the ablation cloud on the lifetime of a solid hydrogen pellet in a plasma.** Parks, P.B.; Turnbull, R.J. (Department of Electrical Engineering, University of Illinois, Urbana, Illinois 61801). *Phys. Fluids;* **21**: No. 10, 1735-1741(Oct 1978).

A knowledge of solid hydrogen pellet lifetimes in a plasma is critical to the design of devices to refuel tokamak fusion reactors. When the pellet is injected into the plasma, the ablated material from the pellet undergoes a transonic flow since it is heated while it expands. Calculations are done on the behavior of the transonic flow for various plasma conditions and pellet sizes. From these calculations, the ablation rate and lifetimes of the pellet are determined. A scaling law is given which allows pellet lifetimes to be easily calculated for any plasma conditions. The results of these calculations give good agreement when compared with experiments.

56293 **Device for microparticle array preparation.** Campbell, M.J. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *Rev. Sci. Instrum.;* **49**: No. 10, 1488-1489(Oct 1978).

A simple device is described for preparing arrays of microballoons to be characterized by radiography for use as laser fusion fuel containers.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

REFER ALSO TO CITATION(S) 56283

56294 (LA-UR—78-1628) **Mixing rules for and effects of other hydrogen isotopes and of isotopic swamping on tritium recovery and loss to biosphere from fusion reactors.** Pendergrass, J.H. (Los Alamos Scientific Lab., NM (USA)). 1978. Contract W-7405-ENG-36. 17p. (CONF-780508—56). Dep. NTIS, PC A02/MF A01.

From 3. meeting on the technology of controlled thermonuclear fusion; Santa Fe, NM, USA (9 May 1978).

Efficient recovery of bred and unburnt tritium from fusion reactors, and control of its migration within reactors and of its escape into the biosphere are essential for self-sufficient fuel cycles and for public, plant personnel, and environmental protection. Tritium in fusion reactors will be mixed with unburnt deuterium and

protium introduced by (n,p) reactions and diffusion into coolant loops from steam cycles. Rational design for tritium recovery and escape prevention must acknowledge this fact. Consequences of isotopic admixture are explored, mixing rules for projected fusion reactor dilute-solution conditions are developed, and a rule of thumb regarding their effects on tritium recovery methods is formulated.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 55638, 56199, 56290

56295 (AD-A—049222) **Light absorption by ion acoustic turbulence in laser-produced plasmas. Interim report.** Manheimer, W.M.; Colombant, D.G. (Naval Research Lab., Washington, DC (USA)). Oct 1977. 33p. (NRL-MR—3582). NTIS PC A03/MF A01.

A review of experiments on light absorption by laser-produced plasmas is presented and the need for another efficient absorption mechanism besides resonant absorption is clearly demonstrated. Laser light absorption by ion acoustic fluctuations is proposed as the missing absorption mechanism. Calculations of this absorption mechanism in a magnetized plasma are then presented. (Author)

56296 (BNL—50817) **Conceptual design of a heavy ion fusion energy center.** Maschke, A.W. (Brookhaven National Lab., Upton, NY (USA)). 13 Mar 1978. Contract EY-76-C-02-0016. 37p. Dep. NTIS, PC A03/MF A01.

A Heavy Ion Accelerator system is described which is based upon existing technology, and which is capable of producing 150 MW of average beam power in 10 MJ, 200 TW bursts, 15 times per second. It consists of an rf linac which accelerates doubly ionized uranium ions to an energy of 20 GeV. Then by utilizing the well known procedure of multiturn injection, a 6.6 ms long burst of linac current is stored in 8 separate "accumulator" rings. At the conclusion of the filling process, a pulsed rf system bunches the beam in each of the 8 rings simultaneously. As the bunches decrease in length, they are then extracted from the rings and transported for about 1 km to one of 5 "boilers", in which the thermonuclear pellet has been placed. The 8 beams (2 opposing clusters of 4 beams each) are then focused simultaneously onto the pellet, resulting in a release of thermonuclear energy about 80 times larger than the input beam energy.

56297 (LA—6982-PR) **Laser fusion program at LASL. Progress report, January 1—June 30, 1977.** Skoberne, F.; Stark, E. (comp.). (Los Alamos Scientific Lab., NM (USA)). Apr 1978. Contract W-7405-ENG-36. 160p. Dep. NTIS, PC A08/MF A01.

Progress in the development of high-energy short-pulse CO_2 laser systems for fusion research is reported. Experiments, which led to the generation of approximately 5×10^8 fusion neutron on our Two-Beam System in early 1977, with laser output powers of 0.16 to 0.4 TW, are described. These significant results and recent theoretical advancements indicate that the CO_2 laser is the driver of greatest promise for commercial laser fusion application. Initial test runs on the Eight-Beam System achieved an output energy of approximately 850 J with one beam of less than 1-ns duration, which makes us certain that the design goal of the system will be met on time. Antares, our 100- to 200-TW target irradiation system, is progressing on schedule. Very promising test results obtained on the prototype, as well as encouraging progress in optics development, are summarized. Modifications to the LASNEX code are described. Further progress in various target fabrication and nondestructive fuel-assay techniques is reported, and the development of new diagnostic tools is described. Among new tools are single-channel and four-channel x-ray diode assemblies, both using aluminum cathodes, to study the time history of soft x-ray emission; and a 10-μm microscope, developed in-house, which aids us in verifying optimum target alignment and laser focusing. A design modification of the magnetically protected reactor cavity concept is being investigated.

56298 (SAND—78-0057C) **Central igniter magnetic targets with voltage shaping.** Sweeney, M.A.; Farnsworth, A.V.; Jr. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 15p. (CONF-780552—2). Dep. NTIS, PC A02/MF A01.

From Conference on plasma science; Monterey, CA, USA (15 May 1978).

A class of high-gain fusion targets which employ direct beam deposition was studied. The targets have a solid DT fuel layer outside a low-density magnetic central igniter. Propagating burn results because alpha particle energy from the magnetic core is deposited in the outer solid-density fuel layer. One finds that the thickness of the solid fuel layer is crucial to target behavior.

56299 (SAND—78-0778C) **High current pulsed linear ion accelerators for inertial fusion applications.** Humphries, S. Jr.; Yonas, G.; Poukey, J.W. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 16p. (CONF-780515—2). Dep. NTIS, PC A02/MF A01.

From Metal deformation modeling) stress relaxation of aluminum; Kansas City, MO, USA (May 1978).

Pulsed ion beams have a number of advantages for use as inertial fusion drivers. Among these are classical interaction with targets and good efficiency of production. As has been pointed out by members of the accelerator community, multistage accelerators are attractive in this context because of lower current requirements, low power flow per energy conversion stage and low beam divergence at higher ion energies. On the other hand, current transport limits in conventional accelerators constrain them to the use of heavy ions at energies much higher than those needed to meet the divergence requirements, resulting in large, costly systems. We have studied methods of neutralizing ion beams with electrons within the accelerator volume to achieve higher currents. The aim is to arrive at an inexpensive accelerator that can advantageously use existing pulsed voltage technology while being conservative enough to achieve a high repetition rate. Typical output parameters for reactor applications would be an 0^+ beam of 30 kA at 300 MeV. We will describe reactor scaling studies and the physics of neutralized linear accelerators using magnetic fields to control the electron dynamics. Recent results are discussed from PULSELAC, a five stage multikiloampere device being tested at Sandia Laboratories.

56300 (UCRL—52000-77-9, pp 16-25) **Glasses for high-power fusion lasers.** Weber, M.J. Sep 1977.

In Energy and technology review.

Neodymium-doped glass lasers, such as those in LLL's Shiva laser system, offer the best chance for early demonstration of the scientific feasibility of inertial confinement fusion. The output of these high-power lasers is determined by the media used for their amplifying and transmitting components. Our research has shown that significant increases in performance are possible with new fluoride-base glasses that have low refractive indices. These new glasses form the basis for more powerful experimental solid-state lasers and are potentially useful for advanced fusion laser systems.

56301 (UCRL—52000-78-1) **Energy and technology review.** Shay, H.D.; Adye, A.P.; Crawford, R.B.; Prono, J.K.; Staehle, J.T. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1978. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

Separate abstracts were prepared for each of the three included sections. (MOW)

56302 (UCRL—52000-78-1, pp 1-8) **Zone-plate coded imaging of thermonuclear burn.** Ceglio, N.M. Jan 1978.

In Energy and technology review.

The first high-resolution, direct images of the region of thermonuclear burn in laser fusion experiments have been produced using a novel, two-step imaging technique called zone-plate coded imaging. This technique is extremely versatile and well suited for the microscopy of laser fusion targets. It has a tomographic capability, which provides three-dimensional images of the source distribution. It is equally useful for imaging x-ray and particle emissions. Since this technique is much more sensitive than competing imaging techniques, it permits us to investigate low-intensity sources.

56303 Ignition of thermonuclear microexplosions by the acceleration of a magnetically insulated foil to ultrahigh velocities. Winterberg, F. (NEVADA UNIV., RENO (USA). DESERT RESEARCH INST.). *Atomkernenergie;* **31**: No. 1, 60-61(1978).

56304 Hydrodynamics of laser-produced plasma with account of the kinetics of particles resulted from synthesis reaction. Gamalii, E.G.; GUS'KOV, S.YU.; KROKHIN, O.N.; ROZANOV, V.B. (AN SSSR, MOSCOW. FIZICHESKIJ INST.). *Fiz. Plazmy;* **1**: No. 6, 904-911(1975). (In Russian).

The paper discusses the effect of charged fast particles (products of thermonuclear reactions) on the state of a plasma. The motion of plasma ions and electrons is described by the hydrodynamic equations and that of charged fast particles by the kinetic equation. The approximation method of the solution of the kinetic equation makes it possible to find the distribution function for charged particles in the phase space. With the aid of the distribution function it is possible to ascertain correction terms for the hydrodynamic equations involving mass, pulse and energy exchange between the charged particles and a laser-produced plasma.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 56287

56305 (CONF-780431—14) **Chemical effects on secondary photon and ion emission of ion bombarded beryllium, carbon, and boron carbide surfaces.** Wright, R.B.; Liu, M.B.; Gruen, D.M. (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From 3. conference on plasma interaction in controlled fusion devices; Abingdon, Oxfordshire, UK (3 Apr 1978).

Beryllium metal has been proposed as a low-Z material for a first-wall coating or liner in tokamak reactor vacuum vessel applications. In this connection, the effects of ion bombardment on the impurity release and erosion properties of beryllium need to be ascertained. The present work has focussed on the effects of oxygen and nitrogen bombardment on the secondary photon and secondary ion emission properties of beryllium. The most significant finding is that both the secondary photon and ion emission are strongly enhanced as a result of oxygen and nitrogen bombardment. This finding is of potential importance to impurity control and transport problems associated with fusion reactor applications of beryllium.

56306 (LA—7255-MS) **Fabrication of an alumina torus for thermonuclear fusion containment.** Hauth, W.E.; Blake, R.D.; Dickinson, J.M.; Rutz, H.L.; Stoddard, S.D. (Los Alamos Scientific Lab., NM (USA)). May 1978. Contract W-7405-ENG-36. 13p. Dep. NTIS, PC A02/MF A01.

A 235-cm-diam torus has been fabricated for plasma containment during thermonuclear fusion experiments. This 30-cm-diam torus consists of sixty 99.5%-alumina segments, 80% of which are assembled by forming vacuum-tight ceramic-to-ceramic seals. Selection of sealing materials and techniques are discussed.

56307 (LA—7267-PR) **Intense Neutron Source Facility. Progress report, January 1—March 31, 1978.** Brown, M.C. (comp.). (Los Alamos Scientific Lab., NM (USA)). May 1978. Contract W-7405-ENG-36. 35p. Dep. NTIS, PC A03/MF A01.

The funds for the construction of the Intense Neutron Source project (INS) at the Los Alamos Scientific Laboratory have been deleted from the Congressional budget upon recommendation of the Department of Energy's Division of Magnetic Fusion Energy. However, Group P-14 members have been completing Title II of the construction contract and at the same time achieving notable progress at the Beam-on-Target prototype.

56308 (LA—7332-MS) **Shielding calculations for the Intense Neutron Source Facility. Final report.** Battat, M.E.; Henninger, R.J.; Macdonald, J.L.; Dudziak, D.J. (Los Alamos Scientific Lab., NM (USA)). Jun 1978. Contract W-7405-ENG-36. 21p. Dep. NTIS, PC A02/MF A01.

Results of shielding calculations for the Intnse Neutron Source (INS) facility are presented. The INS facility is designed to house two sources, each of which will produce D—T neutrons with intensities in the range from 1 to 3 x 10^{15} n/s on a continuous basis. Topics covered include the design of the biological shield, use of two-dimensional discrete-ordinates results to specify the source terms for a Monte Carlo skyshine calculation, air activation, and dose rates in the source cell (after shutdown) due to activation of the biological shield.

56309 (PNL—2648) **Fusion reactor design studies: standard accounts for cost estimates.** Schulte, S.C.; Willke, T.L.; Young, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1978. Contract EY-76-C-06-1830. 105p. Dep. NTIS, PC A06/MF A01.

The fusion reactor design studies—standard accounts for cost estimates provides a common format from which to assess the economic character of magnetically confined fusion reactor design concepts. The format will aid designers in the preparation of design concept costs estimates and also provide policymakers with a tool to assist in appraising which design concept may be economically promising. The format sets forth a categorization and accounting procedure to be used when estimating fusion reactor busbar energy cost that can be easily and consistently applied. Reasons for developing the procedure, explanations of the procedure, justifications for assumptions made in the procedure, and the applicability of the procedure are described in this document. Adherence to the format when evaluating prospective fusion reactor design concepts will result in the identification of the more promising design concepts thus enabling the fusion power alternatives with better economic potential to be quickly and efficiently developed.

56310 (UCRL—50051-77-4, pp 27-44) **Development and technology.** 28 Feb 1978.

In Magnetic fusion energy quarterly report, October—December 1977.

This program is aimed at developing the technology required for carrying out the mirror reactor program. Much of this work applies to the national program and fusion in general; it covers the following areas: Neutral-beam program (including beam direct conversion and vacuum technology). Direct conversion: In addition to direct conversion associated with neutral beams, we have a continuing program to develop efficient direct recovery systems, which are required for reducing power losses from future mirror reactors. Materials program, several key problems on tritium control and handling that must be solved for any large D-T fusion device are being investigated in the LLL tritium laboratory; emphasis is on cleanup of low tritium concentrations in reactor containment buildings and on the containment of tritium by using various low-permeability barriers and coatings to be applied to metal walls. The effects of neutrons on properties of superconducting materials are being investigated using a unique apparatus in which superconducting properties are measured while the specimen is continuously maintained at liquid-helium temperature. Reactor design studies: Design studies of mirror reactors form a basis for evaluation of mirror concepts and for guiding our long-range program. Present emphasis is on delineating features of reactors based on the tandem mirror concept (TMR), on a fission/fusion hybrid reactor based on the TMR, and on an engineering evaluation of a small reactor system based on field reversal. Reactors that are small and candidates for construction the next decade are being investigated in a program sponsored by the Electric Power Research Institute (EPRI).

56311 **Model for life-limiting properties of fusion reactor structural materials.** Mattas, R.F.; Smith, D.L. (Argonne National Lab., IL). *Nucl. Technol.;* **39**: No. 2, 186-198(Jul 1978).

A computer model based on available materials property data has been developed to predict the lifetimes of first wall structural materials under a variety of reactor conditions. The model combines the materials property data with the appropriate ranges of limiting criteria to establish design lifetimes as functions of such relevant parameters as temperature and integrated neutron wall loading. Empirical equations developed from existing literature data were used to interpolate and extrapolate the required materials properties over the desired ranges. The present effort has concentrated on the evaluation of two candidate structural materials, namely, Type 316 stainless steel and a vanadium-base alloy (V—15% Cr—5% Ti). Curves have been derived that show the estimated lifetime and life-limiting property as a function of temperature for a specified set of design criteria, e.g., maximum swelling of 4%, minimum uniform elongation of 1%, and total creep strain of $<1\%$, for an applied stress of 103 MPa (15 ksi). The results obtained indicate a much longer design lifetime for the vanadium-base alloy than for stainless steel under the conditions of interest. The computational model has been incorporated into the Tokamak Power Plant Systems Program at Argonne National Laboratory.

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 55247, 56317

56312 (DOE/AD—0010-1) **Selected DOE Headquarters publications received by the Energy Library.** (Department of Energy, Washington, DC (USA). Energy Library). Jul 1978. 37p. Dep. NTIS, PC A03/MF A01.

This bibliography provides listings of (mainly policy and programmatic) publications issued from the U.S. Department of Energy, Washington, D.C. The listings are arranged by the "report code" assigned to the major organizations at DOE Headquarters, followed by the three categories of environmental reports issued from DOE Headquarters. All of the publications listed, except for those shown as still "in preparation," may be seen in the Energy Library. A title index arranged by title keywords follows the listings. Certain publications have been omitted. They include such items as pamphlets, "fact sheets," bulletins and weekly/monthly issuances of DOE's Energy Information Administration and Economic Regulatory Administration, and employee bulletins and newsletters. Omitted from the bibliography altogether are headquarters publications assigned other types of report codes--e.g., "HCP" (Headquarters Contractor Publication) and "CONF" (conference proceedings).

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 54530, 55798, 55799

56313 (MIT—2295T9-6, pp 75-85) **Appendix II: a comparison of languages for the ASPEN executive.** Nyyssonen, A.; McMains, W. 15 Dec 1977.

In Computer-aided industrial process design: the ASPEN project. Sixth quarterly progress report, September 1—November 30, 1977.

This report discusses the features of FORTRAN, PL/1, and AED that relate positively or negatively to the requirements of an implementation language for the ASPEN executive. The requirements have developed from a combination of recognized needs of a language for building software systems and needs particular to

ASPEN. In an overall comparison FORTRAN's strong point is minimum problems interfacing with existing modules. Its weak points are the difficulty of writing structured code and the problem of implementing the plex concept, character handling, and other data structure needs efficiently. AED and PL/1 are similarly good for writing structured code, implementing ASPEN data structures, efficient use of core, and minimizing the need for assembly language modules. PL/1 has more debugging facilities than AED, while AED has more features for modifiability. Many of the language constructs of AED are less smoothly expressed than the comparable constructs in PL/1. AED input/output and character handling compare less favorably with PL/1. An important short-term issue is the speed of system development while the important long-term issues are maintainability, transportability and efficiency. We feel that the executive system concepts of ASPEN can be implemented faster and be more easily maintained in AED or PL/1 than in FORTRAN. Since the languages produce a code that is equivalent in efficiency, placing proper emphasis on design and optimum tuning can assure an efficient system. Therefore, weighing the consideration of all of the above issues we feel that PL/1 would be the appropriate implementation language for the ASPEN executive.

56314 (SAND—78-0063C) **Structure of the k-centra in a tree.** Slater, P.J. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 9p. (CONF-780105—2). Dep. NTIS, PC A02/MF A01.

From 9. southeastern conference on combinatoric graph theory and computing; Boca Raton, FL, USA (30 Jan 1978).

The concepts of the center and the centroid of a graph, G, can be generalized as follows. For 1 < or = to k < or = to abs value of V(G) and u a member of V(G), let r/sub k/(u) = max[Σ/sub s a member of S/d(u,s):S a subset of V(G), abs value of S = k]. The k-centrum of G, denoted C(G;k), is defined to be the subset of vertices u in G for which r/sub k/(u) is a minimum. Thus, C(G;1) is the center of G, and C[G; abs value of V(G)] is the centroid. A discussion of the structure of these sets for trees concludes with a construction to prove the following theorem: For any tree T' there exists a tree T such that the subgraph induced by union/sub k=1// sup n/C(T;k) is isomorphic to T', where n = abs value of V(T). 3 figures.

56315 (SAND—78-1201C) **Discussion of: confidence interval estimation for the Weibull and extreme value distributions.** Easterling, R.G. (Sandia Labs., Albuquerque, NM (USA)). 1978. Contract EY-76-C-04-0789. 9p. (CONF-780802—2). Dep. NTIS, PC A02/MF A01.

From American Statistical Association meeting; San Diego, CA, USA (14 Aug 1978).

Lawless paper on confidence interval estimation is reviewed and elaborated. The influence of outliers is studied; in particular, the conjecture that confidence intervals obtained by conditioning would be more susceptible to distortion by outliers than those obtained by not conditioning is examined. Nonequivariance of examples and interpretation of intervals are also discussed. It is concluded that, for Weibull data, conditional confidence intervals have practical and theoretical advantages. For data which are only mostly Weibull-like, however, they are not the final word. 1 figure. (RWR)

56316 (SU—326-P30-57) **Generalized conjugate gradient algorithm for solving a class of quadratic programming problems.** O'Leary, D.P. (Stanford Univ., CA (USA). Dept. of Computer Science). Dec 1977. Contract EY-76-C-03-0326-030. 50p. Dep. NTIS, PC A03/MF A01.

Matrix splitting techniques and a conjugate gradient algorithm are applied to the problem of minimizing a convex quadratic form subject to upper and lower bounds on the variables. This method exploits sparsity structure in the matrix of the quadratic form. Choices of the splitting operator are discussed and convergence results are established. Results are presented of numerical experiments showing the effectiveness of the algorithm on free boundary problems for elliptic partial differential equations; comparisons with other algorithms are given. 8 figures, 2 tables.

56317 (UCID—30166(Pt.1)) **Computer graphics by example. Part 1. FTE: how to produce resource-allocation charts.** O'Hair, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 May 1978. Contract W-7405-ENG-48. 21p. Dep. NTIS, PC A02/MF A01.

FTE creates charts that show quickly how time and resources are being allocated. The FTE chart is an easy-to-digest chart showing trends and relationships. It is a useful tool for the planning and communication of ideas at all levels of management in private industry and government. Although it does not replace the detailed analysis of data needed for accurate planning, it shows the big picture, which must first be understood before the details can be accurately interpreted. This report, written for the new user, shows by example how to use the FTE program and edit FTE files. FTE is written in LRLTRAN and runs on the CDC-7600 computers of the Livermore Time-Sharing System (the Octopus Network).

56318 **Invariant integration over SU(N).** Creutz, M. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *J. Math. Phys. (N.Y.);* **19**: No. 10, 2043-2046(Oct 1978).

We give a graphical algorithm for evaluation of invariant integrals of polynomials in SU(N) group elements. Such integrals occur in strongly coupled lattice gauge theory. The results are expressed in terms of totally antisymmetric tensors and Kronecker delta symbols.

56319 **Sequences of Z_2direct-sumZ_2 graded Lie algebras and superalgebras.** Rittenberg, V.; Wyler, D. (The Rockefeller University, New York, New York 10021). *J. Math. Phys. (N.Y.);* **19**: No. 10, 2193-2200(Oct 1978).

Applying methods similar to those used for classical Lie superalgebras (Z_2 graded algebras), we construct sequences of Z_2direct-sumZ_2 graded Lie superalgebras. In this way one obtains the spl(m,n,r,s), osp(m,n,r,s), P_1(m,r), P_3(m,n), ospP$_3$(m,n), P/sub 1,2/(m), and Q (m) series. We also give series of Z_2direct-sumZ_2 graded Lie algebras. Closed forms for superdeterminants and determinants of Z_2direct-sumZ_2 graded matrices are presented.

56320 **Sequential Bayes estimation of the difference between means.** Kelley, T.A. (Los Alamos Scientific Lab., NM). *Ann. Stat.;* **5**: No. 2, 379-384(1977).

It is desired to estimate the difference between the means of two independent normal distributions as accurately as possible and in a sequential manner when the total number of observations is fixed. The problem is posed in a Bayesian framework with conjugate prior distributions and squared error-loss function. It is shown that the optimal sequential design depends on the ratio of the posterior variances of the two means. There exist constants (dependent on the prior parameters, the number of observations taken from each distribution, and the number of observations remaining) such that, when the above-mentioned ratio exceeds this constant, it is optimal to select the next observation from one distribution; otherwise it is optimal to select it from the other distribution.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 55836

56321 (CONF-780615—4) **Design and implementation of an on-line Chemical Dictionary (CHEMLINE).** Kannan, K.L.; Schultheisz, R.J.; Walker, D.F. (Union Carbide Corp., Oak Ridge, TN (USA). Computer Sciences Div.; National Library of Medicine, Washington, DC (USA)). 1978. Contract W-7405-ENG-26. 15p. Dep. NTIS, MF A01.

From National computing conference; Anaheim, CA, USA (5 Jun 1978).

Portions of document are illegible.

CHEMLINE, formerly the TOXLINE Chemical Dictionary, is a chemical nomenclature file for on-line interactive search and retrieval. (DLC)

56322 (TID—4579-R10(Suppl.1)) **Energy information data base. Serial titles.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jun 1978. 40p. Dep. NTIS, PC A03/MF A01.

This supplement contains changes and additions to TID-4579-R10 and is intended to use with that publication.

CIVILIAN DEFENSE

REFER ALSO TO CITATION(S) 55776

56323 (AD-A—050693) **Sensitivity of INR shielding analyses to source and structural variations. Final report 23 Aug 76-31 Dec 77.** Albert, T.E.; Huszar, L.; Simmons, G.L. (Science Applications, Inc., La Jolla, CA (USA)). 31 Dec 1977. Contract DCPA01-76-C-0326. 86p. (SAI—77-867-LJ). NTIS PC A05/MF A01.

Results of a study of three specific items of interest to the development of procedures for estimating initial radiation protection factors for buildings are presented. These include: (1) the effects of new cross section data for nitrogen and oxygen on initial radiation environments; (2) calculations of delayed radiation environments for large yield weapons -- the calculations are based on the NUIDEA code; and (3) sensitivity analyses of the effects of composition, thickness, and design characteristics of wall constructions .

56324 (AD-A—050700) **Structural response to simulated nuclear overpressure (STRESNO): a test program and future analytical tech-**

niques. Volume I. Program description and results. Final report 3 Nov 75-28 Feb 77. Syring, R.P.; Pierson, W.D. (Boeing Co., Wichita, KS (USA)). Mar 1977. Contract DNA001-76-C-0084. 202p. NTIS PC A10/MF A01.

The following: (1) experimental determination of the ability of 17 basic structural elements to withstand simulated nuclear overpressure loads (utilizing Sandia Corporation's THUNDERPIPE Shock Tube) and uniform static pressure loads; (2) analytical determination of the ability of these structural elements to withstand nuclear overpressure loads and uniform static pressure loads (utilizing the NOVA-2 computer program developed by Kaman AviDyne for the Air Force Weapons Laboratory, finite element techniques, and classical strength analysis techniques); (3) identification and evaluation of differences between test results and analysis results; (4) identification of suggested changes to NOVA-2 to upgrade its capabilities; (5) analytical determination of the sensitivity of structural response to selected structural properties; and (6) application of study results to future nuclear hardness assessments.

56325 (ORNL—5368) **Feasibility of citizen construction of expedient fallout shelters. Final report.** Condie, S.J.; Goodwin, R.J.; Seggar, J.F.A. (Brigham Young Univ., Provo, UT (USA); Oak Ridge National Lab., TN (USA)). Aug 1978. 132p. Dep. NTIS, PC A07/MF A01.

Seventeen different families or groups of individuals untrained in building techniques constructed one of the following seven alternative expedient fallout shelters: Door-Covered Trench, Log-Covered Trench, Car-Over-Trench, Above-Ground Door-Covered, Crib-Walled, Ridge-Pole, and Tilt-up Doors and Earth. The builders of each shelter were guided only by one-page instructions prepared for that shelter by Defense Civil Preparedness Agency. Nine of these same families or groups also built an expedient shelter-ventilating pump, following brief instructions of Defense Civil Preparedness Agency. To simulate crisis conditions, the groups were offered a base pay rate for constructing each respective shelter within a specified time frame. If the shelter were completed in half the specified time, an additional bonus was given. With the exception of only one group, all participants received the bonus. Generally speaking, the participants demonstrated that construction of the respective shelters in accordance with the shelter designs was feasible. The builders were less successful in following the brief instructions for making an expedient air pump. Of the nine pumps built, only four would pump air effectively. Numerous suggestions were made by the participants and observers regarding the improvement of the instructions. Among the more general suggestions were: (1) instructions should not be condensed to only one page; (2) brief explanations should be given regarding why certain steps are taken; (3) selection criteria for locating a shelter site should be suggested; and (4) more illustrations which are less complex should be included in each set of plans.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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Acurex Corp., Mountain View, CA (USA). Alternate Energy Div.
Rigid and flexible vent header testing in the quarter scale test facility. Mark I Containment Program, Task 5.3.3, 3:55143 (NEDE—24520)

Adcock (Larry) and Associates, Albuquerque, NM (USA)
Waste Isolation Pilot Plant environmental impact report: socioeconomic portion. An outline of the input-output model and the impact projections methodology, 3:54713 (SAND—78-7061)

Aerospace Corp., El Segundo, CA (USA)
Proceedings of the 13th biennial conference on carbon. Extended abstracts and program, 3:55533 (CONF-770701—(Absts.))

Aerospace Corp., El Segundo, CA (USA). Ivan A. Getting Labs.
Compilation of scientific results from the satellite OV1-17. Final report, 3:55970 (AD-A—050483)
Kinetic study of h + hf(v = 3); kinetic isotope effect and temperature dependence. Interim report, 3:55568 (AD-A—050192)
O2(1 delta)-i atom energy transfer studies: cw inversion on 1.315-micrometer i-atom transition. Interim report, 3:55628 (AD-A—049028)
Satellite observations of polar, magnetotail lobe, and interplanetary electrons at low energies. Interim report, 3:55994 (AD-A—050640)
Signature of a parallel electric field in ion and electron distributions in velocity space. Interim report, 3:55993 (AD-A—050637)
Vlf transmission induced slot electron precipitation. Interim report, 3:55990 (AD-A—049086)

Air Force Aero-Propulsion Lab., Wright-Patterson AFB, OH (USA)
Experimental performance of a 15 kilowatt cw CO_2 electric discharge laser. Final report Jan 76—Jul 77, 3:55633 (AD-A—050469)

Air Force Geophysics Lab., Hanscom AFB, MA (USA)
Significant solar proton events, 1955-1969. Interim report, 3:55971 (AD-A—050642)

Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)
Comparison of heavy ion-induced K-alpha x-ray satellite spectra from gases and solids, 3:56008 (AD-A—050006)

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Solar electric generating system resource requirements and the feasibility of orbiting solar reflectors. Master's thesis, 3:54836 (AD-A—048908)

Air Force Weapons Lab., Kirtland AFB, NM (USA)
AFWL technical objective number 1. Nuclear weapons, non-conventional weapons, direct systems support, and supporting technology, fiscal year 1979. Final technical report Jan 78—Jan 79, 3:55820 (AD-A—050417)
Radiation characterization of sequential logic circuits. Final report, 3:55794 (AD-A—050476)

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Executive summary of the National Solar Energy Workshop of the ERDA Division of Solar Energy and the state energy offices, 3:54822 (ORO—5278-1)

Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center
Executive summary of the Second National Solar Radiation Data Workshop, the ERDA Division of Solar Energy and the state energy offices, Skyland, Virginia, September 26—28, 1977, 3:54827 (TID—28412)
Solar radiation data sources, applications, and network design, 3:54825 (HCP/T5362—1)

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Emergency response to transportation accidents: an overview, 3:54689 (AGNS—1040-17)

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Proceedings of the 13th biennial conference on carbon. Extended abstracts and program, 3:55533 (CONF-770701—(Absts.))

American Museum of Natural History, New York. Dept. of Mineral Sciences
Impact-melt origin for the Simondium, Pinnaroo, and Hainholz mesosiderites: implicatiions for impact processes beyond the Earth—Moon system, 3:55980 (CONF-780314—6)

American Society of Limnology and Oceanography, Ann Arbor, MI
Symposium on ecology and management of the continental shelf, 3:55862 (CONF-7605172—)

American Univ., Washington, DC
Definition of chemical and electrochemical properties of a fuel cell electrolyte. Interim technical report 25 mar 77-24 dec 77, 3:55336 (AD-A—050920)

Argonne National Lab., IL (USA)
Autoradiography as a safeguards inspection technique for unirradiated LWR fuel assemblies, 3:54725 (ANL—78-27)
Benefits and costs of maintaining short-term sulfur dioxide standards in non-urban areas. Paper 78-52.4, 3:55830 (CONF-780636—7)
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Comparison of ICEPEL predictions with single elbow flexible piping system experiment, 3:55595 (CONF-780609—12)
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Critical heat flux under transient conditions: a literature survey, 3:55149 (NUREG/CR—0056)

Design of optimum aquifer reservoirs for CAES power plants, 3:55185 (CONF-780599—5)
Effects of the proposed new source performance standards: a comparative assessment of the energy and economic impact, 3:54942 (ANL/EES-CP—6)
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Estimating the cost for states to implement federal air pollution control strategies, 3:55851 (ANL/EES-CP—9)
Evaluation of steam as a potential coolant for nonbreeding blanket designs, 3:56286 (CONF-780508—55)
Fine definition of ir spectra for certain metallic oxide species. Final report, 1 July 1975—30 September 1976, 3:55585 (AD-A—048814)
Fusion reactor safety studies, FY 1977, 3:56283 (ANL/FPP-TM—111)
Impacts of environmental and utility siting laws on community energy systems, 3:55256 (ANL/ICES-TM—7)
Metal matrix encapsulation of waste, 3:54696 (CONF-780316—13)
Observation of thermal plumes from submerged discharges in the Great Lakes and their implications for modeling and monitoring, 3:55873 (ANL/EES-CP—13)
Overview of liquid-metal MHD, 3:55324 (CONF-780595—3)
Preliminary evaluation of the use of hydraulic air compressors in water-compensated reservoir compressed air storage power plants, 3:55183 (CONF-780599—2)
Recent measurements of the rates of ozone removal from the atmosphere by land surfaces. Paper 78-30.5, 3:55831 (CONF-780636—11)
Response surface techniques developed for probabilistic analysis of accident consequences, 3:55126 (CONF-780507—18)
Study of basic approaches to the design of the primary system of loop-type LMFBRs, 3:54996 (ANL/A—78-3)
Support studies in fluidized-bed combustion. Quarterly report, October—December 1977, 3:55745 (ANL/CEN/FE—77-11)
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Use of reciprocating engines in Compressed Air Energy Storage power plants, 3:55184 (CONF-780599—4)

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Destroyer engineered operating cycle (DDEOC). System maintenance analysis FF-1052 class fuel oil service and transfer system, SMA 112-260. Review of experience, 3:55372 (AD-A—050437)

Arizona State Univ., Tempe (USA). Dept. of Physics
Imaging of surfaces and defects of crystals. Progress report, February 16, 1977—May 1, 1978, 3:55499 (COO—2995-2)

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Effect of molecular rotation on vibrational relaxation. Final report, 3:56007 (AD-A—049064)

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Stratospheric composition balloon-borne experiment 23—26 September 1975. Research and development technical report, 3:55826 (AD-A—049030)

Army Engineer Waterways Experiment Station, Vicksburg, MS (USA)
Subsurface exploration in alluvial terrain by surface geophysical methods. Final report, 3:55948 (AD-A—049125)

Army Facilities Engineering Support Agency, Fort Belvoir, VA (USA). Research and Technology Div.
Fort Belvoir regional energy survey. Final report, 3:55206 (AD-A—050964)

Asphalt Inst., College Park, MD (USA)
Report on emissions from asphalt hot mixes, 3:55931 (RR—75-1A)

Atlantic Richfield Hanford Co., Richland, WA (USA)
Nuclear waste tank and pipeline external leak detection systems, 3:54706 (ARH-ST—127)

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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EG-77-S-05-5362	**Alabama Univ., Huntsville (USA). Kenneth E. Johnson Environmental and Energy Center**	
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ES-77-C-02-4223	**Physical Sciences, Inc., Woburn, MA (USA)**	
	3:55638	COO—4223-3
ES-77-S-02-4252	**Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics**	
	3:55639	COO—4252-2
ET-78-C-09-1040	**Allied-General Nuclear Services, Barnwell, SC (USA)**	
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ET-78-S-02-4726	**Wayne State Univ., Detroit, MI (USA)**	
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EX-76-A-01-2295-026	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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EX-76-A-01-2491	**Midwest Research Inst., Kansas City, MO (USA)**	
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EX-76-A-29-1012	**Jet Propulsion Lab., Pasadena, CA (USA)**	
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EX-76-A-31-1011	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
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EX-76-C-01-1545	**Combustion Engineering, Inc., Valley Forge, PA (USA)**	
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EX-76-C-01-1726	**Curtiss-Wright Corp., Wood-Ridge, NJ (USA). Power Systems Div.**	
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EX-76-C-01-1794	**Ingersoll-Rand Research, Inc., Princeton, NJ (USA)**	
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EX-76-C-01-2006	Utah Univ., Salt Lake City (USA). Dept. of Mining, Metallurgical and Fuels Engineering	
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EX-76-C-01-2295-009	Massachusetts Inst. of Tech., Cambridge (USA)	
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EX-76-C-01-2334	Rice Univ., Houston, TX (USA). Dept. of Chemical Engineering	
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EX-76-C-01-2353	Exxon Research and Engineering Co., Baytown, TX (USA). Baytown Research and Development Div.	
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EX-76-C-01-2489	Institute of Gas Technology, Chicago, IL (USA)	
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EY-6-C-09-0001	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant	
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EY-6-S-05-4760	North Carolina State Univ., Raleigh (USA). Dept. of Nuclear Engineering	
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EY-76-C-6-1830	Battelle Pacific Northwest Labs., Richland, WA (USA)	
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EY-76-C-02-2939	Toronto Univ., Ontario (Canada). Dept. of Mechanical Engineering	
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EY-76-C-02-2975	General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.	
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EY-76-C-02-3043	Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Energy Systems Div.	
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EY-76-C-02-3073	Princeton Univ., NJ (USA). Plasma Physics Lab.	
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EY-76-C-03-0167-056	General Atomic Co., San Diego, CA (USA)	
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EY-76-C-03-0167-060	General Atomic Co., San Diego, CA (USA)	
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EY-76-C-03-0167-065	General Atomic Co., San Diego, CA (USA)	
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EY-76-C-03-0326-030	Stanford Univ., CA (USA). Dept. of Computer Science	
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EY-76-C-03-0893-010	General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.	
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EY-76-C-03-0893-030	General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.	
	3:55008	GEFR—00322
EY-76-C-03-0893-032	General Electric Co., Sunnyvale, CA (USA). Fast Breeder Reactor Dept.	
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EY-76-C-05-0033	**Oak Ridge Associated Universities, Inc., TN (USA). Manpower Education, Research and Tranining Div.**	
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EY-76-C-05-5158	**Franklin Inst. Research Labs., Philadelphia, PA (USA)**	
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EY-76-C-05-5203	**Illinois State Geological Survey, Urbana (USA)**	
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EY-76-C-07-1570	**Idaho National Engineering Lab., Idaho Falls (USA)**	
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EY-76-C-15-1200	**General Electric Co., San Jose, CA (USA). Fast Breeder Reactor Dept.**	
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EY-76-S-02-2479	**Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Nuclear Engineering**	
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EY-76-S-02-2679	**IBM Watson Research Center, Yorktown Heights, NY (USA)**	
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EY-76-S-02-2725	**Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Biochemistry**	
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EY-76-S-02-2826	**Purdue Univ., Lafayette, IN (USA). School of Nuclear Engineering**	
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EY-76-S-02-2995	**Arizona State Univ., Tempe (USA). Dept. of Physics**	
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EY-76-S-03-0326	Stanford Linear Accelerator Center, CA (USA)	
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EY-76-S-05-4254	Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry	
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EY-76-S-05-5111	Houston Univ., TX (USA). Dept. of Physics	
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EY-76-S-05-5246	Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station	
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EY-76-S-05-5278	Alabama Univ., Huntsville (USA). Center for Environmental and Energy Studies	
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EY-76-S-09-0639	Georgia Univ., Athens (USA). Inst. of Ecology	
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EY-76-S-09-0644	Georgia Univ., Athens (USA). Dept. of Zoology	
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EY-76-S-09-0900	Wake Forest Univ., Winston-Salem, NC (USA). Dept. of Biology	
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EY-76-S-09-0965	Wake Forest Univ., Winston-Salem, NC (USA)	
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9	3:55914	*See* ORAU/IEA-78-9(M)
CONF-780314-		(9. lunar science conference, Houston, TX, USA, Mar 1978)
6	3:55980	Dep. NTIS, PC A04/MF A01
CONF-780316-		(Waste management fuel cycles, Tucson, AZ, USA, 5-8 Mar 1978)
13	3:54696	Dep. NTIS, MF A01
CONF-780355-		(American Crystallographic Association meeting, Norman, OK, USA, 20-24 Mar 1978)
1	3:55451	*See* BNL-24230
CONF-780362-		(Two-phase instrumentation review meeting, Troy, NY, USA, 13-14 Mar 1978)
1	3:55121	*See* BNL-NUREG-24357
CONF-780415-		(Scanning electron microscopy conference, Los Angeles, CA, USA, 16-21 Apr 1978)
5	3:54746	*See* UCRL-80269
CONF-780431-		(3. conference on plasma interaction in controlled fusion devices, Abingdon, Oxfordshire, UK, 3-7 Apr 1978)
14	3:56305	Dep. NTIS, PC A02/MF A01
CONF-780450-		(9. conference on modeling and simulation, Pittsburgh, PA, USA, 27-29 Apr 1978)
2	3:55207	*See* BNL-24371
CONF-780501-		(3. international conference on stable isotopes, Oak Brook, IL, USA, 23-26 May 1978)
5	3:55579	*See* LA-UR-78-1583
CONF-780506-		(5. symposium on packaging and transportation of radioactive materials, Las Vegas, NV, USA, 7-12 May 1978)
32	3:54689	*See* AGNS-1040-17
37	3:55620	Dep. NTIS, PC A02/MF A01
38	3:54692	*See* SAND-78-0246C
CONF-780507-		(Probabilistic analysis of nuclear reactor safety, Los Angeles, CA, USA, 8-10 May 1978)
18	3:55126	Dep. NTIS, PC A02/MF A01
CONF-780508-		(3. meeting on the technology of controlled thermonuclear fusion, Santa Fe, NM, USA, 9-11 May 1978)
28	3:56279	*See* UCRL-80631
53	3:55506	*See* UCRL-81028
55	3:56286	Dep. NTIS, MF A01
56	3:56294	*See* LA-UR-78-1628

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2	3:56299	*See* SAND-78-0778C
CONF-780550-		(Seminar on testing solar energy materials and systems, Washington, DC, USA, 22-24 May 1978)
6	3:54856	*See* SAND-78-0881C
CONF-780552-		(Conference on plasma science, Monterey, CA, USA, 15-17 May 1978)
2	3:56298	*See* SAND-78-0057C
CONF-780565-		(SESA spring meeting, Wichita, KS, USA, 15-19 May 1978)
3	3:55155	*See* UCRL-80586
CONF-780579-		(Meeting on picosecond phenomena, Hilton Head, SC, USA, 24-26 May 1978)
3	3:56200	*See* UCRL-80781
CONF-780580-		(Workshop on geothermal drilling fluids, Houston, TX, USA, 23 May 1978)
1	3:54886	*See* SAND-78-1063C
2	3:54887	*See* SAND-78-1064C
CONF-780595-		(Cryogenic Society of America meeting, Chicago, IL, USA, 17 May 1978)
3	3:55324	Dep. NTIS, PC A02/MF A01
5	3:56274	*See* GA-A-15026
CONF-780596-		(32. frequency control symposium, Atlantic City, NJ, USA, 31 May-2 Jun 1978)
1	3:55800	*See* SAND-78-0086C
CONF-780599-		(CAES technology symposium, Pacific Grove, CA, USA, 15-17 May 1978)
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5	3:55185	Dep. NTIS, PC A03/MF A01
CONF-7805102-		(Highway vehicle systems contractors meeting, Troy, MI, USA, 9-12 May 1978)
1	3:55229	*See* ANL/EES-CP-11
CONF-780606-		(Institute of Nuclear Materials Management meeting, Cincinnati, OH, USA, 27-29 Jun 1978)
7	3:55801	*See* SAND-78-1108C
8	3:54741	*See* UCRL-80814
9	3:54729	*See* LA-UR-78-1648
10	3:54742	*See* UCRL-80815
11	3:54740	*See* UCRL-80802
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13	3:54743	*See* UCRL-80818
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17	3:54730	*See* LA-UR-78-1656
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10	3:55111	*See* HEDL-SA-1453
12	3:55595	Dep. NTIS, PC A03/MF A01
CONF-780611-		(AIChE symposium, Philadelphia, PA, USA, 4-8 Jun 1978)
7	3:54766	Inst. of Gas Tech., Chicago, IL
11	3:55832	*See* DP-MS-77-93
CONF-780615-		(National computing conference, Anaheim, CA, USA, 5-8 Jun 1978)
4	3:56321	Dep. NTIS, MF A01
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1	3:55940	Dep. NTIS, PC A02/MF A01
CONF-780619-		(IEEE photovoltaic specialists conference, Washington, DC, USA, 5-8 Jun 1978)
13	3:54833	*See* DOE/NASA/1022-78/33
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4	3:55152	*See* SAND-78-0255C
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50	3:54988	*See* GA-A-14725
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60	3:54677	*See* HEDL-SA-1434
61	3:55508	*See* HEDL-SA-1428
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1	3:54828	*See* UCRL-80569
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6	3:54942	*See* ANL/EES-CP-6
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1	3:54884	Dep. NTIS, PC A02/MF A01
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3	3:55458	*See* UCRL-81201
5	3:55727	*See* LA-UR-78-1600
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1	3:55512	*See* SAND-78-1089C
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3	3:55771	*See* UCRL-80853
CONF-780691-		(Workshop on validation of mathematical models, Dallas, TX, USA, 21-23 Jun 1978)
1	3:55209	*See* UCRL-81357
CONF-780702-		(Symposium on heating in toroidal plasmas, Grenoble, France, 3-7 Jul 1978)
6	3:56178	*See* GA-A-14881
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13	3:55808	*See* SAND-78-8628
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3	3:56174	*See* UCRL-81344
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14	3:54877	*See* UCRL-80974
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CONF-780710-		(22. American Association of Cost Engineers meeting, San Francisco, CA, USA, 9-12 Jul 1978)
3	3:55035	Dep. NTIS, PC A02/MF A01
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6	3:55708	*See* DP-MS-78-53
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1	3:55587	Dep. NTIS, PC A02/MF A01
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3	3:55854	*See* RHO-SA-31
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1	3:56285	Dep. NTIS, PC A02/MF A01
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2	3:55550	*See* DP-MS-77-75
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2	3:54282	*See* UCRL-81252
5	3:54283	*See* UCRL-81302
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1	3:55728	*See* UCRL-81338
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4	3:55957	*See* SAND-78-0781C
20	3:55330	*See* GA-A-14969
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2	3:56315	*See* SAND-78-1201C
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2	3:56196	*See* LA-UR-78-1436
6	3:56201	*See* UCRL-81303

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6	3:54904	*See* K/CSD/INF-77/1(Rev.1)
CONF-780807-		(2. world hydrogen energy conference, Zurich, Switzerland, 21-24 Aug 1978)
1	3:54768	Inst. of Gas Tech., Chicago, IL
8	3:54760	Dep. NTIS, PC A02/MF A01
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2	3:56280	*See* UCRL-80644
3	3:56183	*See* UCRL-80636
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7	3:55615	*See* LA-UR-78-1912
8	3:55616	*See* LA-UR-78-1913
9	3:55614	*See* LA-UR-78-1890
10	3:55613	*See* LA-UR-78-1880
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8	3:55625	*See* SAND-78-0677C
9	3:54538	*See* SAND-78-0630C
11	3:54529	*See* SAND-78-0665C
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1	3:55743	*See* UCRL-81151
CONF-780830-		(Conference on computer aided tomography and ultrasonics, Haifa, Israel, Aug 1978)
1	3:55896	*See* LA-UR-78-1827
CONF-780832-		(9. conference on photochemistry, Cambridge, UK, 7-9 Aug 1978)
1	3:55829	*See* BNL-24610
CONF-780902-		(American Chemical Society meeting, Miami, FL, USA, 10-15 Sep 1978)
1	3:54771	*See* BNL-24477
3	3:54803	*See* BNL-24428
4	3:54770	*See* BNL-24427
7	3:55828	*See* BNL-24383
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1	3:55359	*See* BNL-24568
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23271	3:54276	Dep. NTIS (US Sales Only), PC A04/MF A01
23280	3:55938	The Institute, 5 Princes Gate, London SW7 1QN
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23308	3:54567	U.S. Dept. of the Interior, Bureau of Land Management, Washington, DC
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October 1977

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A17	13.00	E17	40.00	T17	900.00
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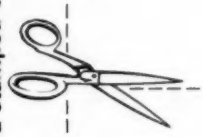

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